

Building Commissioning



Interim Recommended Guidelines

September 2002

Georgia State Financing and Investment Commission

Preface:

This edition of the Interim Recommended Guidelines for Building Commissioning is intended to assist the Using Agency during the development of their Implementation Plan during the Predesign Phase. These Guidelines should be useful, moreover, whenever in the process Commissioning is introduced. This document is the product of several months of discussion and consideration by the parties listed below, but it is not intended to be the final edition. It is anticipated that, once the principles stated herein have been tested, changes to the Guidelines will be necessary. Any comments or suggestions on how to improve this document to make it easier to understand and use would be greatly appreciated.

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Table of Contents

<i>Preface</i>	1
<i>Executive Summary</i>	3
<i>What is Commissioning?</i>	4
<i>Why Commission?</i>	6
<i>When to Commission?</i>	9
<i>Budgeting for Commissioning</i>	9
<i>Commissioning Delivery Methods</i>	9
<i>Selecting the Commissioning Authority</i>	15
<i>Defining the Scope of Work—The Owner's Commissioning Procedure</i>	17
<i>The Commissioning Process—Step-by-Step</i>	20
<i>The Commissioning Process—Predesign/Planning</i>	20
<i>The Commissioning Process— The Design Stage</i>	21
<i>The Commissioning Process—The Constructor Selection Stage</i>	23
<i>The Commissioning Process—Early Construction</i>	24
<i>The Commissioning Process—Static Inspection (Field Verification)</i>	26
<i>The Commissioning Process—Startup (Functional Verification)</i>	27
<i>The Commissioning Process—Shakedown (Performance Verification)</i>	28
<i>The Commissioning Process—O&M Staff Training and Documentation</i>	29
<i>The Commissioning Process—Warranty Review and Seasonal Testing</i>	31
<i>Passing the Baton—Achieving Operational Status</i>	32
<i>Retro-Commissioning (Commissioning of Existing Buildings)</i>	34
<i>Glossary of Terms</i>	35
<i>List of Acronyms</i>	37
<i>Recommended Reading & Organizations</i>	38
 <i>Appendix A: Sample RFQ/RFP</i>	 40
<i>Appendix B: Guiding Documents of the Commissioning Process</i>	59
<i>Appendix C: Typical Building Systems and Components</i>	60
<i>Appendix D: Design Intent</i>	61
<i>Appendix E: Basis of Design Document</i>	64
<i>Appendix F: Sample Preventive Operation Plan</i>	65
<i>Appendix G: Sample Building Commissioning Contract</i>	67

Executive Summary

Commissioning is a planned, collaborative, and systematic process of review and testing conducted to confirm that a structure and its subsystems perform as designed and as expected by the building occupant. In most cases, this procedure takes place during the entire project, from planning and predesign through final acceptance of the building. Commissioning has been shown to improve building quality in thousands of major projects nationwide.

An independently contracted consultant in private practice known as the Commissioning Authority (CxA) typically conducts the Commissioning process. This firm is chosen based on experience and in a manner similar to Consulting Engineers and Architects. Other Commissioning delivery methods exist. Commissioning services can be provided by an in-house staff of Commissioning specialists, by the Architectural and Engineering Design Team, by the Constructor or by some combination of the above.

In awarding Commissioning projects to CxA firms, one should look for a staff that includes both professional Engineers and experienced technicians. One should also expect Commissioning service providers to participate in the national Commissioning community through conferences and continuing education and to be participants in national peer organizations.

In the majority of cases, Commissioning is recommended for at least the mechanical, life safety, and electrical portions of new buildings. Independent third party Commissioning should be performed on new building projects with a construction cost of approximately \$2.5 million or more. This appears to give the best value for the dollar considering Georgia's climate and the types of buildings constructed. In other regions of the country, a testing program for the building envelope and security is often a part of Commissioning. Flexibility in Commissioning different systems will provide the best value for the Commissioning dollar.

Traditional Factors Supporting the Need for Building Commissioning
<ul style="list-style-type: none">• Unclear Design Intent• Complex Building Systems• Increased Specialization Without Integration• Unclear Standards and Criteria for Gauging System Performance• Lack of Functional Performance Testing• Conflicts Between Specifications and Applicable Codes• Inadequate System Documentation• Maintainability and Accessibility Problems• Inadequate Provision for Maintenance• Inadequate O&M Manuals• Inadequate Training of O&M Staff• Numerous Change Orders and Cost Overruns
<i>Source: U.S. General Services Administration Building Commissioning Guide, July 1998</i>

Agencies should anticipate fees of 1.25 percent to 2.25 percent of the new building construction cost as payment to the CxA for total building Commissioning. If agencies choose to commission only select systems, then the recommendation is to budget an average of 2.5 percent of the system component construction cost for Commissioning of that system. These fees are exclusive of travel, videotaping, testing-adjusting, and balancing (TAB) work, and extra certifications beyond occupancy.

While the cost of Commissioning constitutes only a very small part of the cost of the initial construction process, it has been shown to be a significant contributor to the economical construction and maintenance of the facility for years to come.

What is Commissioning?

Simply stated, Commissioning is the process of making sure a building works as intended. A more complete definition is:

Commissioning is a planned and integrated systematic process to ensure, through documented verification, that all Building Systems perform interactively according to the Design Intent. Commissioning procedures require a collaborative team effort and begin in the predesign phase, continue through the design and construction phases into the initial occupancy phase, including the training of O&M staff.

Let us take a closer look at this definition:

Commissioning is *planned*. Benefits from Commissioning can be achieved no matter when the process starts. The earlier one begins the process of Commissioning the greater the potential benefits are. The maximum benefit will be achieved when Commissioning is a part of the project from the very start, ideally during the predesign phase of the project. Furthermore, Commissioning must be *integrated* into the project, meaning that Commissioning is made integral to every stage of the project: predesign, design, construction, acceptance, and post occupancy (warranty).

The factors of *planning* and *integration* are two key points that set Commissioning apart from traditional construction quality assurance processes. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)¹, a leader in HVAC issues, offers a course that is very helpful for becoming acquainted with Commissioning for mechanical systems. Another important resource for learning about Commissioning is the Building Commissioning Association (BCA)², which provides training and certification for Commissioning authorities.

Early approaches to Commissioning did not stress the integrated approach. Recently the trend in Commissioning has become more of a Building or Total Systems Commissioning approach instead of the traditional HVAC or component Commissioning.

Planned and Integrated Commissioning is Crucial

Using Commissioning during the design phase does not significantly change the way the design firm does business. What it does do is provide the design firm with additional information they need to do their job, requires that they document all assumptions, and ensures that they submit quality design products.

Each design option developed by the Design Team must be linked back to the Design Intent. When a specific Design Intent cannot be met, that situation should be identified and the reason given as to why it cannot be met. The project team then evaluates the design options on their ability to meet the Design Intent as a whole. Tradeoffs are made and the Design Intent is updated to reflect the decisions made.

The process of selecting each design option is iterative in that the designers are working as part of the project team to hone the shape, size, and type of facility and components to meet the Design Intent. Sufficient time must be spent during this step to ensure that all questions and concerns have been addressed and agreed to by the project team. Mistakes that are not caught during this step have repercussions throughout the life of the facility.

¹ASHRAE can be contacted in Atlanta, GA at 404-636-8400 or e-mailed at edu@ashrae.org. The ASHRAE web site can be accessed at www.ASHRAE.org.

²BCA can be contacted in Seattle, WA at 206-417-0586. The BCA web site can be accessed at www.bcx.org

The implementation of Commissioning during the design phase is important because of several key services that the Commissioning Authority (CxA) should provide:

- *The CxA should introduce all members of the Design and Constructor Teams to the process early. Early introduction to the Commissioning Plan avoids exposing team members to unexpected reviews and service requirements during the course of the project.*
- *The CxA should confirm that the Design Intent is complete during the Predesign phase. If not complete, the CxA should develop the initial Design Intent document that will be turned over to the A/E team so that the Basis of Design (BoD) can be developed. The Design Intent document is described in more detail later in this paper.*
- *The CxA should check the construction plans and specifications during the design phase to confirm that the documents include provisions for Commissioning, including systems testing and sequence of operation verification.*
- *The CxA should provide the requirements for Commissioning in the specifications so that the Constructor is aware of his responsibilities prior to submitting a bid.*
- *The CxA's presence at prebid and preconstruction conferences should further acquaint construction personnel with the Commissioning process and draw the Constructor(s) into the project team.*
- *The CxA contributes to the documentation of the BoD in several ways. First, the CxA must be able to explain the BoD to the Designers so that they understand what is needed from them. Once the Designers begin submitting their BoD information, the CxA must review the information to verify that it is a quality effort and to help reduce the occurrence of omissions. Next, as a part of the design review, the CxA must also compare the BoD information supplied by the Designers with the Owner's Design Intent, to verify that the design does not violate the Owner's requirements.*
- *The CxA should document any changes that are made to the BoD, and identify them to other members of the Design Team so that the Design Team can insure the coordination of the drawings and specifications.*
- *The CxA can aid the Designers by supplying a sample format for guidance, which is likely to be very valuable to Designers new to the BoD and the Commissioning process.*

Commissioning is Collaborative, Systematic, and Documented

Commissioning is *collaborative*. It is a team process from the very beginning. *One of the most important responsibilities of the CxA is team formation and the development of a communications protocol.* The experienced Commissioning professional verifies that quality is included in the project from start to finish by creating a heightened respect for quality within the team. To be sure, there is a certain amount of error identification, both in design and construction; but in the main, quality is built in, not inspected in.

Commissioning is *systematic*. Commissioning includes testing all items in all modes of operation. Equipment is first inspected in a static condition to assure it is installed correctly (**Field Verification**). Moving equipment is then started up and electrical equipment energized for the first time under controlled conditions (**Functional Verification**). After

equipment is started up, systems of equipment are tested running together to prove that the system as a whole will operate as required (**Performance Verification**).

Systematic refers to the Commissioning building blocks of inspection, startup, and testing. It also refers to the “systems” nature of modern buildings. The Commissioning process is organized by system components, including air handling units, pumps, boilers, chillers, water treatment, fire alarms, smoke evacuation, door locks, roofs, and walls. Grouping the building into subsystems makes it easier to understand how the building works and provides a framework for Commissioning.

Commissioning is *documented*. The value of Commissioning remains long after the building is accepted and turned over to the O&M staff. In the course of Commissioning, key parameters of the systems are documented, organized, and preserved in the Commissioning report. Not the least of these items is the Design Intent. The Commissioning report records the intended use of the building and its various spaces so that if operation and maintenance personnel change, O&M staff will be able to understand why things work the way they do.

The review and approval of the O&M manual and the organization of the training program are also frequently assigned to the CxA. This further insures that the tools required for future correct building operation are provided for the using agency’s operational staff by the time of the completion of the project.

Why Commission?

There are two main benefits of Commissioning:

- The Owner can have assurance of a correctly operating building at completion.
- The Owner can have a basis for confidence in continued correct operation because of documentation and staff training.

Benefits of Commissioning
<ul style="list-style-type: none">• Reduce Change Orders• Reduce Project Delays• Enforce Start-Up Requirements• Shorten Building Turnover Period• Reduce Post-Occupancy Corrective Work• Minimize Effects of Design Defects• Improve Indoor Environment and Employee Productivity• Increase Building Maintainability and Reliability• Reduce Energy and Operating Costs• Increase Value through Better Quality Construction
<i>Source: Heating/Piping/Air Conditioning Magazine, April 1998</i>

To understand these benefits better, consider the increase in the complexity of building components over the past three decades. A greater increase in the complexity of building components has come about in the last thirty years than in the 200 years before. Thirty years ago, buildings operated by microprocessors were a novelty. Now nearly all buildings are operated by a Building Automation System (BAS) and large institutional buildings may have dozens of microprocessors. The same is true regarding automatic valves, actuators, solid-state sensors, occupancy sensors, CO₂ sensors, variable frequency drives, pure water systems, fume hoods, biological hoods, and other modern appurtenances.

Consider the increasing use of technology to meet the demands of safety and efficiency. The energy crisis of the 1970s brought about a huge increase in America's energy consciousness. This is reflected today in building codes as well as design standards. Buildings must operate at a higher level of efficiency than they did thirty years ago. They attain this level of efficiency largely by using the sophisticated components described above, coupled with complex computerized building operating strategies.

Consider also the increase in the use of new materials over the past two decades. New materials have been incorporated into wall finishes, insulation, carpet, ceiling tiles, window coverings, office equipment, furniture, paper, books, cleaning agents, and almost every other item to be found in the modern workplace. All these items either cost less or provide better service. Some do both. Unfortunately, many of them contain untested chemicals that deteriorate the building air quality and cause allergic reactions for some workers unless a building's HVAC systems are operating correctly.

Costs for building construction and operating have been kept lower than they might otherwise be thanks to new building materials, new mechanical and electrical components, and sophisticated operating strategies. However, this new benefit on the construction and operating side of the cost equation has had a detrimental effect when using traditional calculations to budget for design services. Specifically, architectural and engineering design fees have stayed at a constant percentage of construction costs, while building complexity has increased several times over. Formerly adequate budgets for design, set by using a percentage of construction costs from years ago, have become inadequate budgets by using that same percentage calculation.

Requiring that engineering design firms distribute a skimpy design fee among more design details leads designers to spend less time on any one detail. This situation has resulted in professional designers allowing more of their design work to be in the form of standard designs provided by vendors and Constructors, with the additional result that vendors and Constructors may have more knowledge about design details than the design professionals do. Although use of vendor-supplied standard designs works fine in many cases, vendors do not have the same fiduciary responsibility to the Owner than do contracted design consultants. Vendors sell their products based on "low bid," not customer satisfaction. The result is that complexity, originally intended to benefit the Owner, has also placed more responsibility for quality assurance on the Owner's shoulders.

Top 10 Deficiencies Discovered by Commissioning New and Existing Buildings
<ul style="list-style-type: none"> • Incorrect Scheduling of HVAC and Lighting Equipment • Incorrect Heating and Cooling Sequence of Operations • Incorrect Calibration of Sensors and Instrumentation • Lack of Control Strategies for Optimum Comfort and Efficient Operation • Malfunctioning Air- and Water-Side Economizers • Under-Utilized Computer-Based Control Systems • Short-Cycling of HVAC Equipment Leading to Premature Failure • Lack of Design Intent and Building Documentation • Lack of Training for Building Operators or Service Contractors on Complex Systems • Missing Specified and Paid-For Equipment
<i>Source: Portland Energy Conservation, Inc.</i>

Commissioning for Maintenance

In the same way that engineering fees have remained relatively fixed, funding for maintenance and operations has stayed about the same on a unitary (per square foot) basis for a great number of years. Maintenance funding fails to reflect the increased complexity of buildings, as well as the need and cost for education and ongoing re-training of the O&M staff.

An ever-widening gap has come about between what a Constructor installs and what O&M staff members are ready to accept. System components can be correctly sized, specified, and supplied, but not installed, adjusted, and integrated to work optimally on the job. The consequence is that the uncommissioned building does not work correctly when it is built and the O&M staff does not have the time to figure out why. In fact, the O&M staff may be unaware that the building is operating incorrectly until the occupants complain.

Unfortunately, by this time, the building occupants' productivity has been reduced and they have come to expect no better than the poor building environment given them. Already, this new building is in an operations death spiral in which the building staff spend all their time attacking the symptoms of installation and design problems but have no training or time to attack the root causes. Evidence of such a situation may be seen in the bypassing and disconnecting of automatic controls, whether because of a lack of operational and maintenance training or because of equipment that has not been tested and adjusted to work smoothly as part of the overall installation. The result is steadily deteriorating environmental quality in the workspace, reduced energy efficiency, and building performance that falls short of the Owner's expectations.

The cost of these consequences is huge and can easily add up to many times the cost of Commissioning.

Commissioning is the quality management process applied to building construction. It builds quality into the project and confirms correct operation through testing. Quantitative and qualitative data supporting the benefits of Commissioning is available in quantities beyond the scope of this manual.

One of the best resources for a concise listing of Commissioning benefits is the booklet "What Can Commissioning Do For Your Buildings?" by Portland Energy Conservation, Inc. (PECI³). This brief brochure is about twelve pages long and is available in quantities. It is a valuable addition to any program promoting the benefits of Commissioning.

Cost Savings from Building Commissioning
<ul style="list-style-type: none">• Energy Savings of 20 to 50 Percent• Maintenance Savings of 15 to 35 Percent• Reduction of Claims from 2 to 10 Percent• Reduction of In-House Overtime Costs• Reduction of Trouble-Shooting Costs
<i>Source: Building Owners and Managers Association (BOMA) cost data for office buildings</i>

³Portland Energy Conservation, Inc., "What Can Commissioning Do For Your Buildings," Sponsored by PacifiCorp. Contact Carolyn Dasher at (503) 248-4636 or peci@teleport.com.

When to Commission?

Commissioning should be performed on new building projects costing approximately \$2,500,000 or more. Commissioning should also be performed on any system retrofits costing approximately \$800,000 or more. On projects smaller than this, the Using Agency should determine what level of Commissioning is appropriate.

Budgeting for Commissioning

No set standards can be applied to determine the proper cost of Commissioning for every building. The extent of desired Commissioning services will affect the budget requirements. Factors such as building complexity, systems to be commissioned, critical operations inside the building, level of testing required, operation and maintenance goals, training requirements, project duration, and travel requirements all need to be considered in the budgeting process.

Testing of sophisticated electrical systems such as emergency generators, Uninterruptible Power Supply (UPS) systems, automatic transfer gear, etc, when included in the CxA contract will increase the cost of the electrical system Commissioning. (For critical laboratory buildings and data centers it is imperative that the electrical systems undergo extensive testing to ensure the proper operation of all emergency and backup systems.)

Various surveys on the cost of Commissioning have been conducted throughout the U.S. and Canada. These surveys provide a starting point for budgeting. The data collected to date indicate the cost of Commissioning appears to range from 1.5% to 4.5% of the cost of the systems to be commissioned. For a building of average complexity and construction schedule the cost of Commissioning should be about 2.5% of the construction cost for the systems being commissioned. An average cost for basic Commissioning of mechanical and electrical systems appears to be 2.5% and 1.5% respectively. For Commissioning of sophisticated buildings such as research laboratories, this range can rise to 5%. For Commissioning of simple fan-coil systems, the cost will be below these values. In the event that total building Commissioning is desired, the state Predesign Guidelines recommend using 1.25% to 2.25% of the Total Construction Cost in the project budget.

Commissioning Delivery Methods

The “How To” process of Commissioning begins with the decision making requirement of “Which Delivery Method?” As important as it is to implement a Commissioning process, the method selected is crucial to the success of a project. Relationships and trust established at the onset of the project are the significant drivers for success. Many factors and variables (procurement, purchasing, resources, budget, schedule) greatly influence which delivery method is chosen.

Background and Variants

Please refer to the Chapter of the GSFIC State Construction Manual entitled “*Selecting the Appropriate Project Delivery Method*” for a thorough overview of this broad subject and discussion of “Related Issues” as they apply to the overall Design and Construction Delivery Process. As a companion document to the whole State Construction Manual, this section

provides only an overview of the basic variants and methods in the Commissioning Delivery Selection Process. The basic variables are as follows:

- Procurement Method
- Risks
- Responsibilities
- Price/Value

The List of Commissioning Delivery Methods

The combination of variables in the Commissioning Delivery Selection Process has led to the development of five primary Commissioning Delivery Methods:

1. Owner-Led Commissioning
2. Designer-Led Commissioning
3. Constructor-Led Commissioning
4. Independent Commissioning
5. Hybrid Commissioning

These are driven primarily by (A) who holds the contract, (B) who has primary responsibility for completing the work, and (C) the organization and responsibility of the team members.

Other Decisions: Procurement, Purchasing

Other decisions related to delivery include establishing the Procurement and Purchasing Methods. Procurement, in this context, relates to how the selected Delivery Method will be obtained, advertised, and put in place in the project. Purchasing refers to how the delivery method will be paid for, bought, the terms and timing of the deal. *(See “Selecting the Appropriate Project Delivery Method” section for a detailed review of purchasing regulations, price, qualifications, and value selection criteria weighting and related factors.)*

Procurement options include the following:

- Public advertisement
- Prequalified vendors list
- Invited constructors
- On-call/Term/Indefinite delivery contract
- Master agreement
- Sole source
- Bid
- Proposal
- Interview
- Request for Qualifications (RFQ)
- Request for Proposal (RFP)
- Other

Purchasing options include the following:

- Fixed price / Fixed scope of work
- Hourly rates / Unit prices / Variable scope
- Hourly not to exceed / Guaranteed maximum price (GMP)
- Best value / Set price (“We will pay \$50,000—tell us what we get.”)
- Qualifications-based selection (*experience, firm, personnel, references, etc.*)
- Value-based selection
- Other

It is assumed that the owning agency buying Commissioning will have purchasing and procurement regulations and procedures in place to support this process. Therefore, the details of these processes are not enumerated here. Instead, the focus is on explanation of the delivery methods. In subsequent sections, development of the Scope of Work, Scope of Services, and other project specific aspects are covered.

Understanding and Evaluating the Options—Pros and Cons

Pros and Cons stated herein are given for extreme effect to illustrate the stereotypical point. As further illustrative examples, imaginary quotes are listed in “role playing” fashion to demonstrate possible scenarios. We believe that in real life, the teams, players, and examples given may well be more moderate than the examples given here.

At the same time that the project delivery method is chosen and the decision is made to include Commissioning, the Commissioning delivery method should also be determined.

Option 1: Owner-Led Commissioning

In this method, the Owner provides Commissioning via in-house staff. No external third party agent or authority is retained. No Constructor or Designer is contractually responsible for Commissioning. The Owner must have an experienced field Commissioning and management team on staff with the capability to provide all necessary Commissioning disciplines (mechanical, electrical, etc.) in a timely and effective manner.

Pros

- Owner retains control and decision-making ability over all other parties.
- Quick, single-point action is possible.
- No information translation loss from CxA team to Owner.
- May be less expensive (first cost) using in-house staff vs. paid third-party.
- Owner's team retains all the lessons learned during the Commissioning Process.
- Provides the Owner with another opportunity for designer and constructor performance evaluation.

Cons

- Owner may not have enough staff or staff with enough detailed technical knowledge.
- Owner may not be able to maintain impartial control and decision-making ability.
- Owner may not have a sufficiently assertive manager to run the Commissioning process well and resolve conflicts in a timely manner. For example, the case may arise in which a difference of opinion exists between a headstrong design engineer and an unyielding mechanical trade subcontractor about some system requirement, which needs to be resolved decisively and quickly.
- Owner's CxA leader may not be empowered to make decisions, take risks, resolve gray issues, spend money.
- True completion of a commissioned facility may be less likely without the benefit of state of the art industry professionals.
- True total cost, including callbacks, problems, and downtime may greatly exceed the apparent initial savings of not having an external CxA.

Option 2: Designer-Led Commissioning

In this option, the Design Entity assumes responsibility for conducting the Commissioning process or subcontracting for it. The Owner may still manage or subcontract the management of the Commissioning process.

Pros

- High synergy between design and Commissioning entities.
- Designers view Designer-Led Commissioning as a logical subcontract to design; that is, they view it as giving them a “testing” role with the precedent of the Architect/Engineer as Professional/Industry/Owner’s advisor.
- Designer should have a strong understanding of the Owner’s Design Intent.

Cons

- Perception of “fox guarding henhouse” with regard to design issues.
- Traditional adversarial relationship between design/testing entities vs. Constructor can remain.
- Design Team may try to perform this work in-house lacking staff with the necessary skill sets. They may be good Designers, but not experienced in testing and troubleshooting of systems.

Option 3: Constructor-Led Commissioning

In this method, the Constructor provides Commissioning under his contract via in-house staff, trade subcontractors, or an independent entity under contract to the Constructor. The Designer’s contractual responsibilities for Commissioning include the development of the specifications for the Commissioning effort during construction. The Owner relies upon a hired, experienced, field Commissioning and management team rather than in-house staff. All necessary Commissioning disciplines (mechanical, electrical, etc.) are provided. Note: Owning Agency may have to provide CxA management personnel if these are not provided under the agreement with the Constructor.

Pros

- Interdisciplinary problems may be resolved more quickly and with less pain if Constructor is made contractually responsible for construction, Commissioning, and performance.
- Single contract means less coordination and communication by all team members: (“We’ll get it done!”)
- Commissioning costs are potentially lower due to competitive bidding.

Cons

- Perception of “Fox Guarding Henhouse” with regard to construction issues and incentives.
- May depend on Constructor reputation and “unwritten” issues for follow-through.
- Not recommended if Constructor is awarded via low-bid, hard-bid method from a non-selective pool of candidates: (“It wasn’t on the drawings...I’m not putting it in.”)
- Generally, the Constructor is not on board during the design phase, so the development of the Design Intent and other Commissioning functions performed during the design phase will not occur or would have to be performed by another party.
- How does the Owner know the work really was done and that everything is performing as intended?
- Constructors may minimize the Commissioning effort because for every defect found they would need to spend more time and money to have it corrected. (You will not find many problems if you do not look.)

Option 4: Independent Commissioning

In this option, an independent, separate entity assumes responsibility under subcontract directly to the Owner. The Owner may manage or subcontract the Commissioning management component as well. With an independent CxA, two approaches can be taken.

In the first approach, the CxA is limited to a reporting and observers role. He simply documents what he sees while the Constructor or an independent testing agency is responsible for the actual testing of the systems.

In the second approach, the CxA is more hands-on and does much of the testing with their internal staff. This requires a higher level of skill sets, but gives the CxA more ownership in the Commissioning process. It also puts the CxA in a unique position to uncover more problems (especially software-related) that may otherwise go undetected.

Pros

- Classical independent consultant or testing agency opinion (e.g., geotechnical or materials testing) can provide impartiality without a link to profitability or reverse incentives.
- Data are provided directly to Owner (saves time, translation).
- The fox is not guarding the hen house.
- Since they are not responsible for the design, the independent CxA is more likely to ask questions, acting as the Owner's advocate to identify failure scenarios.
- They may bring field testing experience to the design phase.

Cons

- The third party role can result in "reporting" without resolution. Because the independent authority is not responsible for design or construction, the authority may be seen to have no motivation to resolve design or construction issues.
- Who takes the lead to resolve issues or effect change and action where needed? Does this burden fall back to the Owner? Does the A/E or the Constructor step up? Who is the decision maker?
- If not brought on board early enough, or brought without buy-in to the team and the design or construction process to date, the independent firm can lack the "can do" attitude earned by the rest of the team. It may introduce rework, finger pointing, and "Monday morning quarterbacking": *("We never would have suggested those design criteria. If we were involved, that would not have happened. Without a Design Intent Document, we can't really do a proper job of Commissioning, anyway....")*

Option 5: Hybrid Approaches

Owners may be able to combine aspects of some or all of the above methods to best suit their needs. For example:

- An Independent Commissioning Authority may be used with a practical reporting relationship directly to the Owner, but with a subcontract through the Designer or Constructor for accounting or funding reasons.
- The Owner may contract directly for the Commissioning effort and provide management staff, but subcontract the hands-on field component to an external entity.
- Specialty systems may require Commissioning by a specialty testing firm.
- Under a Design-Build Contract, all responsibilities may be contracted under a single contract with a Design-Builder-Commissioner.

- A Design Entity may subcontract for Total Building Assurance as an additional service, with the independent CxA falling under their contract. (Similar to Designer-Led Commissioning, identified above.)
- An independent Commissioning Authority may subcontract with testing agencies to perform the system testing under the CxA's contract. For example, mechanical testing, TAB, testing of the automatic temperature control system, testing of electrical gear and electrical controls, testing of security systems, testing of fire alarm systems, etc., may be performed under subcontracts.

Implementing the Commissioning Delivery Process

Once the decision has been made to include Commissioning, several other decisions are necessary in order to begin the process. For example, one must decide what level of Commissioning is appropriate, when it will begin, and how the appropriate party to perform the services will be selected. Some frequently asked questions are addressed below.

Q: What are the steps to making this happen?

A: Following are the usual initial steps in the Commissioning process:

1. Select a Delivery Method
2. Assign Responsibilities
3. Develop Scope of Work (including Systems, Services, and Performance Period)
4. Develop RFP/Candidates List
5. Review and Evaluate Proposals
6. Select Commissioner

Q: Which delivery method should I use?

A: As soon as the decision is made to perform Commissioning on a project, the Owner should decide the delivery method that will be used. Generally, the appropriate choice of delivery method is determined by a combination of items, including the following:

- The level of sophistication of the building (lab versus a classroom)
- The level of sophistication of the Owner's in-house staff
- The budget that is available for the Commissioning effort
- The skill sets of the parties that will be involved in the construction project (low bid, versus CM, versus negotiated)
- The experience of the Owner with the Commissioning process
- The skill sets of the Commissioning service providers who will be sent an RFQ

Q: When should I select the Commissioning Delivery Method?

A: Ideally, the Commissioning process should be started in the Predesign Phase. If that is not possible, begin in the design phase. The Commissioning Delivery Method should be selected in the early planning process to allow time for the selection of the CxA, and to allow time for the CxA to contribute to the Design Team. As defined previously, Commissioning is a systematic process beginning in the design phase. At this point, the Design Team can begin working with the CxA to (1) develop the Commissioning-focused quality assurance procedures for the design; (2) develop the building product that meets the operational intent; and (3) develop the drawings and specifications that will facilitate Commissioning during the construction phase.

Q: What level of Commissioning is appropriate?

A: The answer is a function of the complexity of the building product and the critical nature of the Building Systems. Obviously, a prison has greater needs than a nature center. The end user and the Design Team should work together to determine the needs.

Q: When do we implement the Commissioning process?

A: In most cases, the earlier in the project that Commissioning activities can begin, the greater the effect they can have on the performance and outcome of the design, construction, and Commissioning process. Various reasons for this advantage include the following:

1. The CxA needs to develop a relationship of trust with the Design Team and with the Owner's staff. When CxAs are brought in late in the design phase, the Designers have a tendency to view them as adversaries and not members of the team.
2. The CxA needs to have a full understanding of the Design Intent. Such an understanding can be communicated more effectively in face-to-face meetings with all parties involved, rather than in written form only.
3. Ideally, the team members selected to perform Commissioning will have extensive experience with startup and troubleshooting of buildings. They may identify design issues that will be much less costly to correct on the drawings than after the systems are constructed.
4. It is important that the Constructor have a clear understanding of the Constructor's role in the Commissioning process. The CxA should list those requirements clearly in the specifications, especially when using a CM to help with the construction budgeting process.
5. The CxA will help to ensure that sufficient balancing devices, measuring devices, and control items are included in the bid documents, which is more cost effective than adding these devices to the project through the "change-order" process.

Q: What are the benefits of early Commissioning?

A: In almost every case, the earlier in the project that the Commissioning activities can begin, the greater the benefit they can bring to the performance and outcome of the design and construction processes, and the Commissioning process itself. Why is this true? Because these processes all profit from collective experience, feedback loops, and lessons learned and shared. If the Commissioning entity is able to influence or create the Design Intent Document, they can bring their knowledge from the field of "what works" to the design stage, resulting in a building that, by design, will have a better chance of working as intended.

Selecting the Commissioning Authority

The manual identifies five separate methods or approaches to Commissioning. This section provides assistance with the selection process to ensure that the selected team meets the requirements of the project and that the team has the necessary skill sets to provide for the successful Commissioning of the project.

Selecting a CxA for Owner-Led Commissioning

For this method to be effective, a suitable relationship should exist between the type of building to be constructed and the experience of the Owner's staff. If the staff members are familiar with the Building Systems to be implemented, have sufficient time to commission the building properly, and are supported by their administration, Owner-led Commissioning can

be a very effective and efficient method of Commissioning. Even so, the CxA must still have all the proper skill sets (both technical skills and communication skills) to lead the Commissioning effort.

After weighing the pros and cons and it is determined that the project can be commissioned by the Owner, the leader should be chosen and made involved immediately.

Selecting a CxA for Designer-Led Commissioning

If the Commissioning activities are to be accomplished by the Consulting Design Team, that team should also be selected based on qualifications as presented through interviews. Therefore, the selection process is essentially the same whether the CxA is a third party or a sub-consultant to the Design Team. If the latter is the case, the CxA should make the Commissioning presentation as part of the Design Consultant's presentation and the team should be selected as a unit. The Design Consultant should not be allowed to switch CXAs after they have been selected for the project. The RFQ should include specific qualifications for the Commissioning team members similar to those used when selecting an independent third party CxA, as identified below.

After the selection, the designer's fee is negotiated. The CxA fee should be a line item in the overall fee and should be negotiated separately from conventional design fees.

Selecting a CxA for Constructor-Led Commissioning (Qualifications-Based Selection)

When soliciting a request for proposal (RFP) from a Constructor, a section should be included that requires the contractor to identify the qualifications of the proposed CxA. The solicitation should be similar to the solicitation (identified below) for use when selecting an independent third party CxA. Prior to awarding the construction contract, the Owner should meet and be comfortable with the proposed CxA. This includes not only the company selected, but also the lead CxA member, the key CxA technical staff, and the planned approach to Commissioning. The Owner should view this as an area of negotiation prior to signing a contract.

If the construction manager (CM) employs the CxA, the CxA should be part of the CM team from the initial response to the RFP. The CM/CxA team should be selected as a unit with no substitutions allowed after the selection.

Selecting an Independent Third Party Commissioning Authority

Independent Commissioning Authorities for public sector construction projects should be selected in the same way we select Consulting Architects and Engineers. The CxA is selected based on qualifications, not through a bid process. This qualifications-based selection process substantiates the view that the CxA provides a professional service, not a commodity; therefore, a "low bid" process is not appropriate for such a selection.

Commissioning firms that perform work for State Agencies should have, at a minimum, the following general strengths:

- *A registered professional Engineer on the staff who will be directly involved in Commissioning activities*
- *An experienced control technician and test and balance technician available for mechanical systems Commissioning*
- *Personnel available who are experienced in the type of system being commissioned*

- *Experience in field Engineering such as remote monitoring or the field troubleshooting of HVAC systems or energy conservation retrofits and programs*
- *Involvement in the professional associations related to Commissioning*
- *Continuing education in Commissioning, consisting of staff attendance at seminars and other training sessions*

The Agency in need of Commissioning services should review the section of the Manual titled “*Selection of Providers of Professional and Construction Services*,” issue an advertisement for services, and select in accordance with those procedures. Generally, firms should be chosen as best qualified for the following reasons:

- *They have the expertise and experience required for the level of complexity represented by the project.*
- *They are capable of providing onsite personnel within a reasonable time frame.*
- *They have the staff size to be able to handle the size of project proposed.*

As the shortlist is assembled, it should be further reviewed with the lead Architect and Engineer of the Design Team. Although the Design Team does not have the right to veto firms selected for the list, they should be given the chance to state objections based on conflicts of interest, past experiences, etc. These objections should then be researched by the Agency, which makes the final decision as to whether the firm in question remains on the shortlist.

After a firm is selected, the Agency should negotiate a fee with that firm based on the scope of work defined in the Owner's Commissioning Procedure. If a mutually acceptable fee cannot be negotiated, another firm on the original list should be selected and negotiations repeated.

A sample RFP is attached as Appendix A.

Hybrid Approaches

A variety of Commissioning methods fall under the classification “Hybrid Approaches.” Regardless of the method used to contract the CxA, the procurement process should be the same. The Owner should follow the process outlined above for selecting an independent CxA. It is important that the Owner is comfortable with the technical and communication skills of the lead CxA member, as well as be confident in the key CxA technical staff and their experience with the Commissioning method selected.

Defining the Scope of Work—The Owner’s Commissioning Procedure

After a state agency decides to incorporate building Commissioning into a project, two critical decisions must be made:

- Which Commissioning delivery method to use
- Which systems and specific components will be commissioned (scope of work)

We have already discussed the advantages and disadvantages of the possible Commissioning delivery methods. Because no two state agencies are alike, each agency should select the Commissioning delivery method that best meets the needs of its particular

project. This decision is influenced primarily by the size, composition, workload, and technical skills of the agency staff, as well as by the desired Commissioning scope of work.

Deciding which specific systems and components to commission is primarily a function of the facility size, the complexity and criticality of the planned systems, and the funds available specifically for Commissioning. The Owner's project manager must judge which Building Systems are the most critical and will return the greatest benefits from Commissioning. The result of this process is a systems list that becomes the heart of the Commissioning RFP. This systems list forms the basis of the scope of the Commissioning work and is the forerunner of the *Preliminary Commissioning Plan* (included in the bid specifications) and the *Commissioning Plan* (released during construction). (See Appendix B, "Guiding Documents of the Commissioning Process"). The development of the systems list may be an iterative process with minor revisions occurring based upon the input of the Design Engineer and issued to the Commissioning RFP during the bid process by means of addendums.

A graphic representation of the various systems and subordinate components found in modern buildings is provided in Appendix C. The figure is certainly not all-inclusive, but does capture the most common systems components encountered today. No building has all of these components, but nearly every building has a majority of them. If an agency chooses to commission every system and subordinate component, such process is called "total building Commissioning." As a minimum, most Commissioning providers recommend Commissioning the major mechanical, electrical and plumbing components, life safety systems, and any system or components deemed critical to the operation of the facility.

In developing the systems list, it is important to note that most modern Building Systems do not operate independently. The advent and use of building automation software has advanced systems interoperability to an exact science, requiring systems to operate in concert. To demonstrate this point, consider the following example:

A fire breaks out on the upper floor of a multi-story building. The smoke detector in the return-air ductwork senses the smoke and sends an immediate message to the building's fire protection system. Several things then simultaneously and automatically happen. The damper controls for the air-handling units for the affected floor go to a "closed" position for smoke control. The fire protection system's auto dialer sends a message to the 911 dispatcher and broadcasts a FM radio signal to the supporting fire department. The stairwell pressurization system comes on to prevent smoke from entering the emergency stairwell exits. Elevators are recalled to the ground floor and parked for fire department and emergency use. The fire protection system broadcasts a building-wide warning over the public address system. The security gate at the loading dock automatically opens to allow fire department and emergency vehicle access. If the fire continues to spread, sprinkler heads activate and jockey pumps automatically switch on to provide adequate water pressure.

As this example illustrates, multiple Building Systems are intended to interact without human intervention. The problem with traditional quality control and quality assurance methods in building construction is that each system is tested discretely, but rarely (if ever) are they tested as an integrated system. Proper building Commissioning will address both discrete operations (functional tests) and the interoperability of the systems and components in the systems list (performance tests).

Deciding the desired level of involvement of the CxA in the O&M training is another important factor in developing the Commissioning scope of work. O&M training will be discussed in more detail at the end of this chapter.

As stated earlier, the availability of funds specified to support Commissioning will also influence the development of the systems list. Ideally, Commissioning costs are included in the predesign phases of project development, using preliminary cost estimation guidelines. These cost estimates can be further refined during the Commissioning procurement process.

Independent Commissioning Authority's Proposal

The CxA proposal can be divided into two distinct components: (1) the initial response to the RFQ and (2) fee negotiations.

1. Response to the RFQ

It is imperative that the respondents demonstrate in the response to the RFQ that they have a clear understanding of the needs of the project and the Owner's vision of the Commissioning process. Providing more project-specific Commissioning information in the RFQ will result in better and more complete proposals. The sample RFQ in Appendix A includes a scoring sheet that may be used when scoring the responses. The process for selecting a CxA is similar to the process for selecting a Design Firm, so the same techniques are relevant.

Anyone hiring a Commissioning Authority should meet each respondent's lead CxA team member as well as their key technical CxA staff in order to assess their abilities as communicators. In Commissioning, communication skills can be as important as technical skills. A CxA team leader with good communication skills may be crucial in bridging any communications gap between the Constructor Team and the Design Team.

2. Fee Negotiations

A well-prepared scope of services document that clearly defines the Owner's vision for Commissioning will help in the fee negotiation process. At the completion of design, an experienced CxA will be able to develop detailed spreadsheets that identify tasks involved in the Commissioning process and the respective time to complete those tasks. As those spreadsheets are reviewed, it will become clear if the service provider and the Owner have the same vision for Commissioning.

However, when the CxA is brought into the project early it will be impossible to identify tasks because systems and quantities of components have not yet been defined. In this instance, it is more appropriate to work with the CxA to negotiate fees by phase.

1. **Predesign Phase Services.** If the CxA is asked to help with formulating the project scope, it may be reasonable to negotiate either a Time and Expense contract or a Fixed Fee contract for just this portion of the project.
2. **Design Phase Services.** After the scope of the project is developed, a fee can be negotiated for the design phase services of the CxA. After the project size and anticipated systems have been preliminarily selected, the CxA will be able to provide a fixed fee for design-related services.
3. **Construction Phase Services.** At the completion of the 65% construction documents, the CxA can develop its fee and detailed Scope of services to be provided during the construction phase. Negotiations on these should be completed prior to completion of the 95% construction documents to allow time for adding the proper wording in the construction specifications.

The Commissioning Process—Step-by-Step

A comprehensive view of the integrated Commissioning process can be considered to have nine distinct phases in the following order:

1. Predesign/Planning
2. The Design Stage
3. The Bidding Stage
4. Early Construction
5. Static Inspection (Field Verification)
6. Startup (Functional Verification)
7. Shakedown (Performance Verification)
8. O&M Staff Training and Documentation
9. Warranty Review and Seasonal Testing

The Commissioning Process—Predesign/Planning

The most important components of this early phase of the project are the Design Intent and the Basis of Design (BoD) documents.

The Design Intent is the Owner's *intention and expectation* of the *design and operations* of the building. It is the Owner's requirements for a successful building. In order for the project to be successful, the project team must achieve these requirements and document the achievement. The components and systems tested must meet the Owner's project requirements (and the occupants' needs) in order for the overall building to be considered as operating correctly.

As the criterion for correct building operation, the Design Intent may include only major Building Systems, or it may include a description of correct operation for everything in the building from power quality to cabinet latches. The Design Intent is complete in its scope and verifiable in its requirements.

Regardless of what the document includes, it is architectural in origin: having been developed in association with the project Design Team. The document is performance-based and concentrates on what the occupants *need* instead of focusing on how the Design Team will provide it.

This does not mean that architectural considerations are foremost in the document. If only mechanical and electrical systems are being commissioned, then a sufficient Design Intent may be 90% those disciplines and 10% architectural issues (such as building code requirements, occupancy, etc.). The Design Intent, once complete, is then turned over to the A/E Design Team; they have the responsibility to develop the BoD—the primary document that translates the Owner's needs into building components such as occupancy type, room size, population, air quality, etc. The Design Team will produce design documents based on the BoD.

The job of the CxA is to assure that components have been supplied and installed correctly according to the bid documents, and to assure that the occupant's needs are met as described in the Design Intent. Therefore, the CxA needs both the Design Intent, based on the Architect's knowledge of the occupants' needs, and the design itself, showing the specified solution.

The Design Intent should not be kept a secret during the construction process. The Design Team at the prebid conference should present it and solicit ideas from the Constructor. It is

true that the Constructor will build according to the plans and will expect change orders for any work not shown on the plans. It is also true that some Constructors will count on making money from such change orders and so will tend not to suggest improvements prior to bidding. However, some Constructors may make such suggestions prior to bidding if they are given a chance to see the actual intent of the structure. If they are given only the design, and not the intent, they cannot be expected to help improve the project without change orders.

The document should be presented again at the preconstruction conference. The presentation of the Design Intent document at the prebid and preconstruction conferences should be used as a team-building tool in defining a common goal. This is where the communication and team-building skills of the CxA are very important.

When the Design Intent is presented to the Constructor Team, it should be accompanied by the Basis of Design. The Basis of Design explains how the Design Team chose certain systems and space arrangements to meet the needs of the occupants.

The most basic inclusion in the Design Intent is the general description of the building type (for example, prison, hospital, classroom, geriatric, office, etc.). Beyond the building type, details are stated such as the occupant's age group, particular needs with regard to air quality, outside air volume, occupant load, and pattern of occupancy.

For instance, the Design Intent might describe an assembly area that is to hold one hundred persons for two hours, be empty for an hour after that, all the while providing comfort and operating at maximum energy efficiency. The Basis of Design could specify a variable air volume system integrated with occupancy sensors and special programming, while the actual design in the bid documents could specify components, air volumes, and the required control sequence. Commissioning would assure that the equipment has been supplied and installed correctly, the air volumes and control sequence are correct, and the overall system "works" at each occupancy level.

Appendix D provides a summary of the elements that should be included in the Design Intent document. Following this summary is an example of a Design Intent narrative. Appendix E provides a summary of the elements of the Basis of Design. The BoD describes the actual technical approach planned for the project as well as the actual design parameters to be used.

The Commissioning Process—The Design Stage

The CxA can enhance quality during the design stage after a competent review of the design documents. The CxA should coordinate this review with any design review the Owner may perform. Generally, reviews performed by GSFIC's Design Review Group are limited to programmatic and code compliance and constructability issues. The review performed by the CxA should determine, at a minimum, that the documents—

- Are consistent with the Design Intent
- Specify commissionable systems
- Include inspection and testing details
- Include equipment parameters that can be verified
- Incorporate a layout that allows testing and maintenance
- Fully describe the Commissioning process for the bidders

The CxA should review the contract documents during development and should offer comments and recommendations.

The review process does not transfer responsibility for the design, nor is it intended that the CxA “check” or “warrant” the design. Responsibility for design rests fully with the design professional. However, the review process should be used to provide an additional quality control feature to augment the design process.

The Owner should monitor this process and make certain that procedures are in place within the team so that issues the CxA raises are reviewed and the team comes to a consensus about them. If a consensus cannot be reached on an issue, the process should document the issue and the Owner should provide a decision and direction in consultation with the appropriate design professional.

The CxA will also review the contract documents to confirm that each piece of equipment or system is capable of being tested and has objective performance parameters that can be confirmed. For example, the CxA will confirm that pumps and other hydronic devices have test ports specified to allow flow measurement and maintenance access at air handling units or at straight duct lengths where airflow measurements must be taken.

Writing the Specifications

The CxA should develop the Commissioning specifications during the design stage. These specifications should be included in the appropriate division as determined by the Construction Specification Institute's (CSI) 1995 *MasterFormat*TM classification of construction systems⁴.

Division 1 sections that would be modified to include information about Commissioning include the following (actual numerical designations may vary slightly):

- 01011—Summary of the Project
- 01030—Alternates
- 01310—Construction Progress Schedules
- 01330—Submittal Procedures
- 01400—Quality Requirements
- 01730—Operation and Maintenance Data
- 01770—Closeout Procedures

Division 15 sections include the following:

- 15000—General Provisions/Testing and Balancing
- 15990—Testing, Adjusting, and Balancing

Division 16 sections include:

- 16000--General Provisions

The Preliminary Commissioning Plan

While writing the specifications for Commissioning, the CxA develops the Owner's original Commissioning procedure into a Preliminary Commissioning Plan. This plan extends the Owner's original system-by-system Commissioning procedure into a scope of work that names actual components and systems in the design documents. The CxA should develop procedures for each of the systems to be commissioned. This interim plan should be incorporated into the specifications to give the Constructor the best possible idea of his part in the process. After the bid is awarded and submittals are approved, the CxA writes the

⁴ See Construction Specification Institute at <http://www.csinet.org/specify/csindex/csindex.htm>. Note that the MasterFormatTM is under revision for possible expansion that would change the numbering of its current divisions.

formal Commissioning Plan that completely describes the Commissioning work. (See below—"The Commissioning Process—Early Construction.")

The Preliminary Commissioning Plan is one document of six that define the Commissioning process from beginning to end. These documents start with the Design Intent Narrative and end with the Commissioning Final Report. Appendix B lists these guiding documents and their part in the overall process.

The Commissioning Process—The Constructor Selection Stage

The selection of the Constructor is a brief but important time in the Commissioning process. This is the first opportunity to bring the Constructor(s) into the process, and it is vital that the Constructor cooperate in the Commissioning process if the team is to reach the goal of a quality building. Constructor personnel perform the inspection and testing required by the CxA. It takes Constructor time, and it costs the Constructor money. It also saves the Constructor time and money through reduced callbacks and the early and fair resolution of problems. Overall, the Constructor and subcontractors will save more than they spend on Commissioning, although they may not believe this at first.

As the bidders/proposers prepare their bids/proposals, there will be questions about their roles in Commissioning. The CxA should answer these questions, either at a prebid/preproposal conference, in writing, or both. Although Commissioning is still a new and developing practice in the state of Georgia, GSFIC has found that most Constructors readily accept Commissioning once they understand it. Furthermore, they accept the process much more readily if the CxA exhibits a positive, helpful, cooperative approach right from the start. This is a key aspect of independent third party Commissioning as opposed to Constructor or Design Team Commissioning. The CxA team leader should have above-average leadership and team building skills.

In addition to answering Constructor questions, the CxA may need to answer questions for the Design Team. This is especially true if the project bids/proposals come in over the cost estimate. The CxA may be called upon to evaluate the savings in Commissioning costs that should result from cutting portions of the project out to make the required budget. Indeed, the CxA may be required to help defend the Commissioning process itself from elimination in view of a budget problem.

Most projects of a significant size (\$5,000,000 or larger) follow a bid/proposal process similar to the following:

1. Distributing the construction documents (plans and specifications)
2. Advertising for bids/proposals on state websites
3. Conducting the prebid/preproposal conference/walk-through
4. Issuing the first addendum—answers to questions from the prebid/preproposal conference
5. Issuing subsequent addenda for questions submitted after the prebid/preproposal conference
6. Collecting the sealed bids/proposals
7. Opening the sealed bids/proposals
8. Evaluating the bids/proposals with regard to budget
9. Selecting deductive alternates according to the budget
10. Reselecting if required by budget
11. Awarding the project
12. Receiving the Constructor's submittal of insurance and bond certificates
13. Issuing the notice to proceed

Of these steps, the CxA will be involved to some extent in the following:

3. Conducting the prebid/preproposal conference/walk-through
4. Issuing the first addendum—answers to questions from the prebid/preproposal conference
5. Issuing subsequent addenda for questions submitted after the prebid/preproposal conference
8. Evaluating the bids/proposals with regard to budget
9. Selecting deductive alternates according to the budget

When the prebid/preproposal conference is organized, the CxA should be placed on the agenda to present a brief overview of the Commissioning process and answer specific questions posed by the Constructors. The questions and answers that come out of this conference, including those related to Commissioning, should be recorded in the minutes and issued in writing to all bidders/proposers as an addendum. The CxA should provide answers to Commissioning questions to the Owner's Project Manager.

Subsequent addenda will answer questions posed to the Owner and Design Team after the prebid/preproposal conference; however, they may or may not include Commissioning questions. All Commissioning questions posed by the Constructor should be routed through the Owner and then to the CxA to assure that each response is sent in an identical form to all Constructors and all members of the Design Team. The CxA should review any addendum to confirm that revised drawings and specifications do not reduce the Commissioning requirements or capabilities. The CxA should stay alert to any changes in construction time as related to addenda. If there are significant changes in the project that will affect the time for CxA services, make sure adequate time is added to the Constructor's construction time in the addenda to allow for Commissioning.

Proposals to cut Commissioning because of cost should be met with resistance. It is wrong to compromise quality because of budget concerns. No matter what else stays or goes, quality is indispensable.

The Commissioning Process—Early Construction

The beginning of the construction process includes the following Commissioning-related activities:

- Preconstruction meeting
- Development of the construction schedule and schedule of values
- Submittal of equipment and materials
- Completion of the final Commissioning Plan

During the early stages of construction, the CxA will continue to answer questions for the Constructor and verify that Commissioning is being integrated into the construction process. The best venue for this is the preconstruction meeting.

The first item of discussion is the schedule. Developing the schedule is actually two tasks: 1) getting Commissioning milestones placed on the construction schedule, and 2) including contractor Commissioning activities in the schedule of values. The construction schedule and schedule of values are key documents that allow the Owner to track the construction process. Having Commissioning included in these is a good way to confirm that the Constructor is an active part of the Commissioning team.

The CxA works with the Constructor and, if necessary, the subcontractors to discuss phasing and timing of Commissioning. This schedule gives the Constructor an idea about what Commissioning information must be included in the Constructor's overall schedule. The Constructor is required to integrate the information into the overall schedule of the project. In this way, all subcontractors are given additional notice about the requirement for Commissioning.

When the schedules are submitted, copies are routed to the CxA for review with regard to Commissioning milestones. The Commissioning milestones shown on the tentative schedule of Commissioning activities should be integrated into the overall schedule by the time the schedule is submitted for approval. Although it is true that this schedule may be revised many times before the bulk of the Commissioning activities are accomplished, these activities should be a part of the schedule from the start. As other milestones are revised, the Commissioning schedule should be revised accordingly.

On some projects, the State may contract with a professional to manage the Owner's daily on-site construction responsibilities. This work includes accepting and processing requests for information, processing change orders, evaluating weather conditions, and conducting construction meetings. As the project progresses, the CxA and the Owner's manager should coordinate their activities.

As the Constructor makes equipment submittals to the Design Engineer, the manager should route copies of the approved submittals to the CxA for information only. The CxA does not approve submittals (that is the Engineer's job), but the CxA does comment to the Owner if there is anything in the submittals that appears seriously wrong. The CxA should make sure that any submittal requirements for items key to Commissioning are not left off Constructor submittals.

Commissioning procedures include static inspection, startup, and functional test descriptions. The CxA writes and assembles these procedures as part of the Commissioning Plan as equipment information is available from submittals. As the documents are completed, they should be submitted to the Owner's manager and the Designer for approval, and then to the Constructor for scheduling. Meetings between the CxA and the Constructor serve to further clarify the intent of the process and keep the Constructor involved.

The final draft of the Commissioning Plan is completed during the early stages of construction after all equipment submittals have been approved and before equipment has arrived on the site. It starts with the requirements on a system-by-system basis and provides more detail based on the actual design and the equipment ordered. The Commissioning Plan developed at this point should have detailed information on the support required from Constructor Personnel. Specifically, each inspection and test should be annotated to show the responsible subcontractor. This document will be used by the General Constructor's superintendent to schedule personnel to assist the CxA in testing and inspection (see Appendix B).

The *ASHRAE Commissioning Guideline 1-1996* and the *USDOE Model Commissioning Plan and Guide Specifications* (Section II)⁵ provide further information on the development of the Commissioning Plan and suggest how such plan fits into the planning and design process.

⁵ "The HVAC Commissioning Process," Guideline 1-1996 (supercedes Guideline 1-1989); Approved June 1996. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, Georgia.

The Commissioning Process—Static Inspection (Field Verification)

As the Commissioning Plan is completed, equipment is ordered, and the building foundation and framing is beginning, the static inspection phase of Commissioning begins. The static inspection phase lays the foundation for equipment startup by confirming that equipment is installed in such a manner that it can function in a safe and effective manner. In general, this includes verifying items in the list below, among other things.

- Equipment location: Are unit locations according to plans and practical requirements? For example, are air handling units positioned to allow full access door openings for maintenance?
- Installation of instrumentation: Are installations performed according to manufacturers' requirements (such as laminar flow for flow sensing devices) and according to Engineering requirements (such as duct pressure sensors located 3/4 of the distance to the furthest point in a VAV duct system)?
- Drain piping: Are drains sloped as specified and have pipes been pressure tested?
- Sheaves: Are all sheaves aligned properly?
- Connection to power and other utilities: Have utility connections been verified?
- Pipe and duct support: Are these items properly suspended for safety and function?

The CxA provides checklists to construction personnel to carry out these inspections. These checklists incorporate manufacturers' requirements and other basic steps that typically would be done even without the Commissioning process and, therefore, should not take a great deal more time to process than would the normal checkout procedure. As the Constructor submits completed checklists, the CxA spot-checks the forms. If the checklists have not been completed accurately, shortcomings will become known as the group attempts to begin Functional Performance Tests (FPTs). If FPTs are cancelled and rescheduled, the Constructor is responsible for the cost of repeat testing (an important notice to be included in the specifications).

Examples of inspection activities are as follows:

Piping and HVAC Ductwork

- During construction, piping and ductwork should be inspected for correct installation and should be pressure tested.
- Items affecting maintenance, such as valve locations, damper access panels, plumbing cleanout access, and sloped piping for drainage, etc., should be checked during construction inspections.
- Domestic water and sanitary sewer piping testing is a Contractor Quality Assurance requirement—as well as a code requirement—and should be witnessed by the Owner's representative, the Architect, or the CxA.
- Low-pressure (less than 3 inches static pressure water gauge) ductwork need not be pressure tested. However, all ductwork should be inspected visually before insulation for correct joining and supports.
- Testing, adjusting, and balancing (TAB) of air and water systems should have been preliminarily performed and ready for startup of the HVAC equipment. CxA to verify.

Air Handling Units and Other Major HVAC Equipment

- Air handling units (AHUs), make-up air units, rooftop heating and cooling units, and similar equipment should be inspected for mechanical items such as properly functioning case drains, filter seals, maintenance access, general air tightness, and vibration isolator supports.
- Control devices, such as sensors and actuators, should be verified as complete according to the Building Automation System (BAS) points list and control diagrams. These devices should be correctly located and completely and soundly installed.
- All electrical wiring is to be confirmed as installed properly, in conduit, terminated, grounded, and tested to confirm power and correct polarity (for motor rotation).
- HVAC piping should be inspected for air handling units, including coil connections, control valve locations, balance valves and test ports, bypasses, drain pans and traps, and maintenance isolation valves.
- Lubrication points for fan and motor bearings, as well as all movable supports, should be checked and mounting fasteners confirmed.

Building Automation System (BAS) Controls

- The controls contractor should perform a complete Point-To-Point checkout of all control devices throughout the building. Checkout is used to confirm that the Engineer's point list is installed as designed. CxA to validate.
- For laboratories or other critical environments as defined by the Owner, all input and output devices in the critical zones should be calibrated to NIST (National Institute of Standards and Technology) traceable standard at the job site. Critical devices are defined in the contract documents in the I/O summaries or I/O list. Factory calibrations are not acceptable. The CxA must certify that this activity has taken place prior to Functional Performance Testing.

Electrical Systems

- During construction, power feeder cables are to be tested for proper insulation and dryness. Owner representative or CxA should monitor tests.
- Switchgear, panelboards, etc., are to be inspected for proper connections and grounding.
- Authorized testing companies should certify building electrical grounding and lightning protection systems.

Fire Protection and Life Safety Systems

- Fire Service water line piping is to be flushed and tested; NFPA (National Fire Protection Association) certificate is required.
- Aboveground fire protection piping is to be flushed and tested (preferably per floor). Witness is normally by local fire officials. NFPA certificate is required.
- Smoke and heat detection sensors at air moving equipment are to be checked and verified for proper installation.

The Commissioning Process—Startup (Functional Verification)

Equipment is to be started up for the first time with required factory representatives in attendance. The equipment should be tested at all required speeds and preliminary programming should be completed as required to allow subsequent safe and easy starting. On most projects historically, the main issues that arise during equipment startup are related to control software for the temperature control system.

The Commissioning Process—Shakedown (Performance Verification)

After equipment has been proved at startup, Functional Performance Tests (FPTs) are to be conducted to confirm that the pieces work together. Tests must confirm that smoke causes air handling units (AHUs) to shut down and dampers to go into smoke-control modes. Other tests must assure that valves open on calls for heating and cooling and close when the setpoint is satisfied. Tests should further assure that AHU economizer cycles respond to outdoor air temperatures and indoor calls for cooling, and that freeze protection actually shuts down the required equipment. AHU discharge temperature control should be checked at the unit and at the central energy management and control station.

Dampers should be cycled and checked for leakage, especially face and bypass dampers on steam coils. All actuators should be stroked full-open and full-closed to check for binding, calibration, and correct Building Automation System (BAS) addressing.

Functional tests include checking BAS parameters, such as programmed addresses, sensor calibration factors, occupied/unoccupied programming, and trend logging. Programming charts, sequences of operation, block wiring diagrams, and wiring termination diagrams should be included in the report. All BAS tuning variables, such as response times, damping variables, delays, and interlocks, should be included in the report.

Laboratory and other critical facilities, as defined by the Owner, will have the control input and output points loop calibrated. Inputs will be simulated with signal generators (4-20mA, 0-10vDC, etc.) and values reported on the central station console to be checked against published loop calibration tolerances of the manufacturer. Outputs will be loop calibrated so that when the system calls for an output device to be at the 50% open position, the device is physically checked to be in that position. 10% open and 90% open are also checked in addition to full open and full closed. Variable speed drives will also be checked in this manner.

A sample of items included in the subcontractor's Testing, Adjusting, and Balancing (TAB) report should be checked for accuracy. If a substantial failure rate is encountered, all failures should be corrected and a different sample chosen for a repeat test at the Constructor's expense. GSFIC suggests starting with checking 20% of air distribution terminal devices such as grills and registers. Check all TAB parameters on AHUs and associated return/exhaust fans. On critical facilities such as laboratories, clean rooms and data centers, the Owner may want to check 100% of the TAB readings. If the CxA has the capacity to perform the TAB with its own forces, the Owner may elect to have the CxA perform TAB.

The Functional Performance Tests are the heart of the Commissioning process, but they are also the most difficult and time consuming. This is when the team-building skills of the CxA pay off. If the CxA has succeeded in gaining the trust of the Constructors by this time, the chances of completing the FPTs in a timely manner will be markedly increased. The best method of earning and keeping a good working relationship with Constructors is constant communication. As the FPTs proceed, the CxA should constantly keep the Constructors informed as to upcoming testing.

As inspection and testing proceed, the CxA may find a number of items that do not appear to work as intended. In some instances, the intended operation will be unclear and, in such cases, the CxA should submit a Request for Information (RFI) to the Design Team through the Owner's manager in the same manner that a Constructor would submit an RFI. After confirming the intended mode of operation, the CxA can proceed with testing.

If equipment or systems are found to be malfunctioning, these problems should be listed on a deficiency form or listing. This form should indicate the test and item involved; it also

tracks the status of the problem as it is corrected. The CxA will need to perform a varying amount of retesting because of system and equipment failures during the initial testing. It is good practice to allow some time for retesting in the budgeting process because some equipment will always fail. The amount of retesting that is paid for by the Owner and the amount that is passed back to the Constructor should be very clearly spelled out in the construction contract

The Commissioning Process—O&M Staff Training and Documentation

A properly designed and constructed building cannot function properly without an adequately trained Operations & Maintenance (O&M) staff. Unfortunately, inadequate O&M training is a traditional shortcoming on most construction projects. Problems with O&M training include unqualified trainers, insufficient training time, and incomplete O&M manuals and record drawings. Training is often conducted before systems are fully functional (before the completion of performance verification testing), or is focused on *discrete* systems while failing to address the *interoperability* of modern Building Systems. Building users also tend to send the wrong personnel to training sessions, or miss scheduled training sessions entirely. The result of errors such as these will be an ill-prepared, overwhelmed O&M staff, and building problems from the start.

A qualified Commissioning Authority's requisite in-depth knowledge of the Design Intent and Building Systems makes them an ideal candidate to assist in O&M training. The following is a list of things the CxA should do to have a significant positive impact on O&M training:

- **Recommend the necessary O&M staffing (total personnel, qualifications, and required shifts) to satisfy the Owner's operational intent.** Early identification of the O&M staffing requirements is essential for new buildings because customers often need a long lead-time to hire additional in-house maintenance personnel or to out-source their O&M staffing to a private service provider. Unfortunately, building users are often ill prepared to develop their own O&M staffing requirements. A popular misperception is that modern building automation systems and equipment reduce O&M staffing requirements. Nothing could be farther from the truth. Properly functioning Building Systems are more energy efficient, and provide greater user comfort, but they are also complex systems that require greater operator skills and involvement than similar buildings from even 10 years ago. A qualified CxA is well suited to provide a recommended O&M staffing plan as early as the design phase of the project.
- **Develop a facility preventive maintenance plan.** This task is directly tied to the development of the O&M staffing. The Commissioning Authority can develop a facility preventive maintenance plan that makes best use of O&M staffing to ensure that systems are properly maintained and running at peak efficiency.
- **Review facility record drawings.** The accuracy of facility records can be verified during functional and performance verification testing.
- **Prepare framed instructions showing the sequence of operations and interoperability for major systems and components.** Framed instructions displayed beside major equipment items (chillers, boilers, air handling units, HV units, emergency generators, etc.) can be a major aid for training, routine preventive maintenance, and equipment troubleshooting.
- **Develop master equipment lists for the transfer of real property to the customer.**

- **Document warranty coverage and warranty claims procedures (both standard warranties and any extended manufacturer's warranties).** Most standard warranties provide one-year of coverage for major equipment items from the date of installation. This warranty date may be weeks or months before building turnover to the customer. In some instances, manufacturers will offer equipment warranties beyond the standard one-year period, while others may include limited services during the warranty period. This type of information is usually found either in the equipment documentation or in the O&M manuals. The CxA should research the appropriate documentation and prepare a consolidated warranty list for the customer.
- **Prepare a recommended list of spare parts, bench stock, overbuy, and special tools/equipment required for the first year of building operation.**
- **Review O&M manuals.** O&M training should never be performed without the benefit of completed O&M manuals. Regrettably, O&M manuals are often incomplete, or they are completed *after* the scheduled O&M training. The CxA can provide quality assurance by reviewing the O&M manuals for completeness, accuracy, and timeliness.
- **Coordinate and supervise Constructor and subcontractor O&M training (using the system's O&M manuals and framed instructions).** Usually, the Constructor should schedule all O&M training, but the Commissioning Authority can coordinate and supervise O&M training to ensure that it meets users' needs.

O&M training is not a traditional task for Commissioning Authorities, but it is one for which they are well suited. The Constructor (with oversight by customer) traditionally provides the services shown above, or else the customer performs these tasks themselves. Unfortunately, many customers are not staffed to manage these activities. Customers desiring the Commissioning Authority's assistance with O&M training should include specific O&M training tasks in their Commissioning RFP.

The Commissioning Final Report

By the completion of training or shortly thereafter, the CxA should have completed the Commissioning Final Report. This report is a collection of all that has gone on before. As such, it contains copies of the following:

- Design Intent
- Basis of design
- Pre-functional checklists complete
- Functional checklists complete
- TAB reports
- System schematics
- Control strategies and set points
- Deficiency log
- Guidelines for energy accounting

The Commissioning Final Report, the TAB report, the O&M manuals, and the record drawings and specifications form the bulk of the documentation that will be left with the O&M staff at the new building. Additional information on building controls that includes block wiring diagrams, as-built control diagrams and sequences of operation will also be included in either the Commissioning Final Report or the O&M manual.

The Commissioning Process—Warranty Review and Seasonal Testing

The First Year of Building Operation

At the completion of training and all other work required by the contract documents, the building will be occupied. There should be a specific notice in the specifications indicating to the Constructor that the successful completion of Commissioning is a requirement for the issuance of the Architect's Final Certificate.

Issues may arise during the one-year warranty period, but if the CxA process has been followed, the issues should be minor and readily handled by the O&M staff armed with documentation and training. Overall, the commissioned building should provide the working environment required for the occupants and the O&M staff can concentrate on establishing an effective Preventive Maintenance Program that should work for the life of the building.

Seasonal Testing

Given Georgia's weather extremes it is likely that certain parts of the building mechanical system cannot be adequately tested due to the season of the completion. For instance, testing of a boiler system might be difficult in the summer and testing of a chiller and cooling tower might be difficult in the winter. Checking an outside air percentage is much easier when there is a substantial difference in temperature between the outside air and the return air.

For this reason, Commissioning Plans should include off-season testing to allow testing certain equipment under the most appropriate test conditions. This requirement must be clearly spelled out in the specifications because it will require some Constructor personnel to return to the site after the project is completed. It is also necessary to withhold money for this activity in addition to that usually withheld for warranty items.

It is also recommended to have the systems tested during the shoulder seasons (spring/fall). Items to look for include proper dehumidification sequences and partial load performance of mechanical systems.

Building Automation System (BAS) Trend-Logging

During the completion of Functional Performance Testing, the CxA is also asked to assist in the programming of the BAS to include the trend logging of a selected group of key performance indicators. These indicators usually include temperatures and pressures for boiler and chiller operations, duct pressures, outside airflows, and some typical variable air volume (VAV) boxes operating parameters, and unitary equipment performance parameters.

Trend-logging is a valuable part of the training program and allows the staff to get started on the right foot, thus ensuring that the established building performance is maintained for the life of the building. Some specification writers may ask that temporary flow monitoring equipment be installed to verify system operation. The agency's Designer should consider making the flow monitoring equipment permanent and include it as part of the project so that the operations and maintenance staff can continue to use the instrumentation.

Continued CxA Contact

As described in previous sections, the CxA has been involved with the project throughout and will have gained valuable knowledge regarding the systems and their operating characteristics. At project completion, the CxA will have a better understanding of the building than even the installing Constructors will. The CxA's contract, as a minimum,

should provide the agency with the ability to engage the CxA for occasional, informal consultations throughout the warranty period or during approximately the first year of building operation. This type of contact should typically be telephone conversations.

If complicated problems develop that involve conflicting opinions among the Owner, Designer, and Constructor, or if problems arise that relate to specific issues identified during Commissioning, an additional services contract with the CxA may prove worthwhile. Expecting the CxA to provide extensive services that were not identified in the original contract is unreasonable without compensation.

The Owner should be concerned about ensuring the ability of the O&M staff to operate the building in the first year of operation. Having periodic monthly training sessions attended by the CxA for consultation with the staff—for example, about trend-log results and other emerging issues—would help the Owner's staffing objectives. Off-season testing should be coordinated with these site visits. A better approach, however, is described in the next section.

Passing the Baton – Achieving Operational Status

Effective Building Operations

Completing the Commissioning of the facility is the first step in successful building operations and energy efficiency management. After the facility has been turned over to the user group, specific user actions and tasks must occur on a regular basis in order to ensure the continued benefits of Commissioning and energy efficiency. Even though these goals would have been documented in the Design Intent, without user involvement in an ongoing effective building operations program, the building and its equipment will degrade over time unnecessarily fast.

Preventive Operations and Maintenance Program

In order to protect, for example, the energy management goals of the Owner after building turnover, a customized preventive operations and maintenance program should be implemented. During Commissioning of the project, care should have been taken to ensure that equipment sizing occurred to match the building loads. Such process will yield tremendous benefits to the Owner because equipment can then be operated at the highest level of efficiency. However, without a preventive operations and maintenance program, these benefits can evaporate. The Georgia State Financing and Investment Commission's intention in promoting Commissioning as a standard component of construction is that Cx will ensure that a building's users will have adequate tools to continually monitor and operate their facility as it was designed to be operated as soon as a working building has been turned over to them.

After receiving an efficient building, the next challenge for Owners and operators is to ensure that the efficient performance of the facility will continue over time. Operational activities of the maintenance staff must be documented clearly in order to protect the Owner's investment. A preventive maintenance (PM) plan is a vital part of any preventive operations and maintenance program (PO&M Program) that can be expected to lead to energy efficient building operation. Owners can benefit by implementing a PM plan to help prevent performance degradation and by tracking the performance of every piece of major equipment.

Without question, equipment and system performance will degrade over time. Below are some typical reasons (provided by the EPA⁶) for performance degradation:

- Schedule changes that are intended to be temporary often become permanent. Tenants, facility managers, custodial staff, service contractors, controls contractors, and others change energy management systems and other equipment settings without recording or documenting the changes.
- Power outages may alter schedules for time clocks and energy management systems.
- Renovations, additions, and build-outs may not incorporate consideration for operational issues.
- Efforts to ensure efficient equipment operation may be partially wasted if the equipment runs during hours when it is not needed.

The goal of a PM plan is to improve equipment reliability and increase equipment life. A functional O&M plan completes the picture by optimizing facility operation to provide significant energy savings and comfort benefits. A good O&M plan is a risk reduction strategy helping to insure that equipment runs efficiently, functions properly, and does not fail prematurely. A good PO&M Program can even lengthen the life of equipment. The CxA should provide the Owner with a PO&M Program that contains not only a detailed PM Plan, but also a functional O&M plan. The functional O&M plan combines the elements of the basic O&M plan with details that provide for equipment to be operated in the most energy efficient manner. PO&M Plans differ from typical PM Plans in that they call for periodic checks for operational and control issues. These PO&M periodic checks also call for investigation of issues that affect efficiency. Examples include the questions of when and how long equipment operates and what causes a piece of equipment to cycle on or off, or fail.

Selection and Training of Building Operations and Maintenance Personnel

Poor maintenance adversely affects operational performance. Likewise, poor operation practices can increase the amount of maintenance required to keep equipment running. The best preventive maintenance and operational programs will include training that increases the overall level of knowledge of O&M personnel, thus allowing them to optimize building operations.

Because Building Systems are now more complex and often involve computerized controls, the qualifications required of potential employees are greater. The Owner's organization should develop selection standards in order to ensure that new hires have these basic skills. For hired staff who do not have all the skills needed, the Owner should, at a minimum, assist in making available on-the-job training and outside training to advance O&M staff toward the desired competency.

Practical entry-level training is available from a number of sources. Where it is appropriate to increase the general knowledge level of existing personnel, there are adult programs run by local technical colleges of the Georgia Department of Technical and Adult Education (DTAE) and through the Georgia Department of Labor. Indeed, DTAE, in addition to basic

⁶ The writers of this document extend appreciation to the Climate Protection Division of the U.S. Environmental Protection Agency (EPA) for the development of a group of work concerning operations and Preventive Maintenance Programs. The example provided in Appendix F was developed under funding from the U.S. EPA, U.S. DOE, and Portland Energy Conservation, Inc. (PECI).

computer and technical equipment training, is often receptive to requests for adding and structuring courses to meet specific employer needs.

Once a basic skill level exists, the CxA becomes a valuable training source not only for the specifics of operating and maintaining the commissioned equipment, but also for providing the background information needed to assist the Owner's O&M staff in understanding system operations and being able to apply practical preventive maintenance functions.

By using the resources of a CxA, the Owner's O&M staff should be able to focus on how and when equipment operates, and address maintenance and repair issues more effectively. Just as the O&M staff should perform certain maintenance tasks to prepare equipment for an upcoming heating or cooling season, there also should be a seasonal review and adjustment of the operation strategies themselves through use of a comprehensive O&M program.

Retro-Commissioning (Commissioning of Existing Buildings)

Up to this point, we have discussed the Commissioning process for new buildings and facilities, but an equally important concept is the Commissioning of existing buildings, or Retro-Commissioning.

The benefits of Retro-Commissioning are similar to those for Commissioning new buildings; energy and operating cost savings, improved indoor environment and employee productivity, and increased building maintainability and reliability. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recently estimated that Retro-Commissioning could result in savings of 5 to 15 percent, with payback in less than two years.

Retro-Commissioning requires a greater amount of experience and analysis in developing the desired scope of work when compared to the Commissioning of new buildings. Retro-Commissioning is generally harder to perform and more expensive than Commissioning new buildings because the equipment is already installed and is not always easily accessible.

Typical candidates for Retro-Commissioning include buildings with complex systems over ten years old, buildings with excessive operational or utility costs, any building that is experiencing significant environmental control problems, or buildings that the intended use has changed. Even buildings that were commissioned when they were new can deteriorate over time. Buildings can get so far out of control that operators spend all their time reacting to temperature and environmental control problems, at the expense of routine preventive maintenance.

The first step in Retro-Commissioning is to determine the original Design Intent for the building, and to verify if it still meets the user's needs. If the building Design Intent is still valid, then the next step is to measure how far the building has strayed, and to develop a plan to bring it back into compliance. However, in many cases, Retro-Commissioning may reveal that the original building Design Intent no longer meets the user's needs. In the worst case, these instances could require the assistance of an Architect Engineer to design a major renovation project for the building.

Glossary of Terms

Basis of Design (BoD). The BoD explains how certain systems and space arrangements were chosen by the Design Team to satisfy the requirements of the Owner's Design Intent.

Building Automation System (BAS). The automatic system used for controlling equipment in a building. Most likely, this will be a computer-based system, including either pneumatic or digital components, or both.

Building Systems. The architectural, structural, mechanical, electrical, and control aspects of a building, along with their respective subsystems, equipment, and components.

Commissioning (Cx). Commissioning is a planned and integrated systematic process to ensure, through documented verification, that all Building Systems perform interactively according to the Design Intent. Commissioning procedures require a collaborative team effort and begin in the predesign phase, continue through the design and construction phases into the initial occupancy phase, including the training of O&M staff.

Commissioning Authority (CxA). The qualified person, company or agency that plans, coordinates, and oversees the entire Commissioning process.

Commissioning Final Report. The document prepared during the acceptance phase of the Commissioning process after all Functional Performance Tests are completed. It includes an executive summary, building description, the completed Commissioning Plan, and all documentation generated during the process, along with completed Commissioning Test Plans.

Commissioning Plan. The document prepared for each project that describes all aspects of the Commissioning process including schedules, responsibilities, documentation requirements, and Functional Performance Test requirements. The level of detail in the document depends on the scope of the specified Commissioning activities.

Commissioning Test Plan. The document prepared for each system, piece of equipment, or energy efficiency measure that details the pre-functional test, Functional Performance Test, and the necessary information for carrying out the testing process. The test plans are included as an appendix to the final Commissioning report.

Control Strategy. An approach to controlling equipment. Usually this term refers to automated routines implemented through an energy management system that are designed to control equipment while providing maximum energy efficiency.

Datalogger. A stand-alone, electronic data-gathering device that uses sensors to collect equipment information over time. Data collected could include temperature, pressure, current, humidity, or other operational information.

Design Intent. The Owner's intention and expectation of the design and operations of the building. The Design Intent establishes the Owner's requirements for a successful building.

Functional Performance Test. The full range of checks and tests carried out to determine whether all components, subsystems, systems, and interfaces between systems function in accordance with the Design Intent. "Function" includes all modes and sequences of control operation, all interlocks, and conditional control responses and all specified responses during design day and emergency conditions.

Indoor Environmental Quality (IEQ). Refers to the total environment of a building and includes thermal comfort, proper illumination, adequate outside air ventilation, and control of indoor air pollutants.

O&M Assessment. A systematic method for identifying ways to optimize the performance of an existing building. This assessment involves gathering, analyzing, and presenting information based on the building Owner or manager's requirements.

Payback. The length of time that an energy-efficient improvement will take to provide the full return on investment.

Preliminary Commissioning Plan. The initial scope of work for the Commissioning Plan developed in the predesign or early design phase of the project. The Preliminary Commissioning Plan names the actual components and systems selected for Commissioning.

Preventive Maintenance Program. A proactively implemented program that addresses equipment maintenance. The goal of such a program is to perform maintenance tasks on a regular schedule in order to maximize the operational efficiency and lifetime of the equipment.

Retro-Commissioning. The process of assessing, analyzing, and upgrading the operational performance of an existing building. Retro-Commissioning usually results in a number of low-cost or no-cost activities that save energy while maintaining or improving comfort.

Short-cycling. Equipment that goes through a complete on/off cycle too often is said to be short cycling. Continued Short-cycling operation can reduce the life cycle of equipment, waste energy, and cause ineffective control.

List of Acronyms

A/E	Architect Engineer
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BAS	Building Automation System
BCA	Building Commissioning Association
CM	Construction Manager
CSI	Construction Specifications Institute
Cx	Commissioning
CxA	Commissioning Authority
DDC	Direct Digital Control
EMS	Energy Management System
EPA	Environmental Protection Agency
GSFIC	Georgia State Financing and Investment Commission
HVAC	Heating Ventilating and Air Conditioning
IAQ	Indoor Air Quality
IEQ	Indoor Environmental Quality
NEBB	National Environmental Balancing Bureau
PECI	Portland Energy Conservation, Inc.
PM	Preventive Maintenance
RFI	Request for Information
RFP	Request for Proposal
RFQ	Request for Qualifications
TAB	Testing, Adjusting, and Balancing
USDOE	U. S. Department of Energy

RECOMMENDED READING

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ORGANIZATIONS

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<http://www.ashrae.org/>

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Georgia State Financing & Investment Commission

PROJECT NO. _____, [PROJECT DESCRIPTION]

Request for Qualifications and Proposals to provide Commissioning Services

Date _____

Table of Contents

I. Introduction

- A. Purpose
- B. Project Objectives
- C. Project Assumptions
- D. CxA Qualifications
- E. Conflict of Interest in Project

II. General Instructions

- A. Building Program
- B. Selection Process
- C. Preproposal Conference
- D. Proposal Instructions
- E. Information Regarding Scope of Work During Phases of Project
- F. Schedule of Events

III. Qualifications and Proposal Submission Format and Requirements

- A. Request for Qualifications
- B. Request for Proposals

IV. General CxA Selection Criteria

- A.
- B.

V. Additional Conditions

- A.
- B.

Georgia State Financing & Investment Commission

Request for Qualifications and Proposals to provide Commissioning Services in connection with the construction of
Project No. **[Number; Project Description]**

I. Introduction

A. Purpose

The Georgia State Financing and Investment Commission (GSFIC) (Owner) on behalf of the **[insert Agency]** has responsibility for construction of **[Project Description]** in **[City]**, Georgia, and is considering the services of a Commissioning Authority (CxA).

The project has gone through the predesign phase and a predesign report is available for review. The Architect of record will complete the balance of design. The management structure is traditional design/bid/build with full design documents and specifications developed by an A/E firm. The construction documents will be let out to bid and a Constructor will be hired to complete the construction. The Design Team will have limited construction oversight.

The CxA will be expected to work closely with the Architect **[Name of Firm]** to develop the final plans and specifications to include the requirements for Commissioning. *[If required by the construction project delivery method selected, the CxA will also be expected to work closely with the Architect to develop final documents and separate bid packages.]*

B. Project Objectives

The **[insert Agency]** intends to secure a contract for a qualified consultant who shall provide building Commissioning services for the **[insert name and location of facility]**. Upon contracting for services, the successful proposer shall serve as CxA on behalf of the **[insert Agency or GSFIC]** and shall provide professional and specialized services in any appropriate technical discipline within the broad field of Commissioning.

In selecting a firm, GSFIC will place emphasis on experience of the firm and its assigned personnel in providing functions on projects of similar magnitude and complexity as the proposed project. GSFIC will prefer firms oriented to the construction field that have depth, knowledge, and resources in the principles of general contracting, scheduling, contract coordination and compliance, budget control, and familiarity with State, County and City laws, ordinances, and codes. Certified Minority Business Enterprises are encouraged to respond to this request.

C. Project Assumptions

[Insert project description and assumptions]

D. CxA Qualifications

It is the **[insert Agency or GSFIC]**'s desire that the CxA satisfy as many of the following preferences as possible:

1. The CxA will have acted as the principal CxA for a least three projects over 50,000 square feet. The CxA will have acted as principal CxA for a project of a similar type facility as the project at hand.
2. The Commissioning team members shall have extensive experience in: 1.) the operation and troubleshooting of HVAC systems, 2.) direct digital control (DDC) systems, 3.) lighting control systems, and 4.) testing, adjusting, and balancing (TAB) of HVAC systems. Extensive (minimum of five years) field experience is required for this type work and systems.
3. Team members have knowledge and experience in building operations and maintenance, and have provided O&M training.

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

4. Team members have experience in energy-efficient systems design, and Control Strategy optimization.
5. Team members have experience writing Commissioning specifications and test procedures.
6. The team has a principal-in-charge that is a professional Engineer in the State of Georgia, with other Engineers as appropriate that are also registered Engineers. Project managers, lead field Engineers, and field support staff may be non-Engineers who have had technical training, past field experience and skill in Commissioning, especially in the areas of TAB, HVAC operations, DDC systems, and electrical system operations. The required expertise for this project must be part of the skill and experience set of the firm making the proposal.

E. Conflict of Interest in Project

Neither the CxA nor any of its officers shall hold an interest in a business enterprise that has other current involvement in the same designated project. The Commissioning firm shall be an independent contractor, not associated with the A/E of record and not associated with a construction firm. Any such business affiliation may present the appearance of a conflict of interest in matters of client obligations to the [insert Agency], and will thereby disqualify the CxA from providing Commissioning services for this project.

II. General Instructions

A. Building Program

1. General
The project will be designed and constructed to a level of quality and timeliness that reflects the long-term use of a State-owned facility.
2. Construction Budget
The preliminary construction budget for the project is \$[insert construction budget amount]
3. Construction Schedule
Although no final schedule has been established, the [insert Agency] has targeted [insert date] for occupancy. CxA will be responsible for assisting in the developing the preliminary schedule and coordinating activities to accomplish the scheduled completion of the project.

B. Selection Process

1. Georgia Code Title 50 Chapter 22
GSFIC will generally follow the requirements of Georgia Code Title 50 Chapter 22 with respect to the selection of a Construction Manager for the proposed project.
2. Selection Committee
The selection of a Commissioning Firm will be by a Selection Committee consisting of representatives of the Architect, [insert Agency], and GSFIC.
3. Request for Qualifications (RFQ)
The Selection Committee will receive and review Statements of Qualifications and Performance Data in response to the "Request for Qualifications for Commissioning Services." Review of responses by GSFIC and [insert Agency] representatives will result in a shortlist of three to five firms to be interviewed. Responses to the RFQ will be evaluated first against a set of weighted criteria to determine those firms most qualified and suited for this project. Qualifications alone will narrow the field to a shortlist of finalists—three to five firms—who will be invited to interview and to submit their Fee Proposal. **RFQ responses will be due by the time and date shown in the Schedule of Events (Section II f), at the GSFIC office located in Suite 1002, West Tower, Floyd Building, 2 Martin Luther King Jr Drive, Atlanta, Georgia 30334.**

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

4. Request for Proposals (RFP) and Interview Shortlisted Firms

Candidates interviewed will be ranked, with the highest ranked firm selected to enter into contract negotiations. Selection will be based on a combination of qualifications and price (consisting of CxA's Fee). The Fee Proposal is to be submitted in a sealed envelope at the time of the interview. Fee will be a contributing, not deciding factor in the selection. At the conclusion of the interviews, the Owner will then negotiate a contract with the highest-ranked firm. If negotiations are not successful, the Owner will then negotiate with the second-ranked proposer, and so on.

C. Preproposal Conference

A Preproposal Conference is scheduled to be held at the time and date shown in the Schedule of Events (Section II f) in the [insert location of preproposal meeting]. Attendance at the preproposal conference is mandatory in order to be considered for selection.

D. Proposal Instructions

1. Request for Contractor Qualifications

Please refer to the attached Section III for further instructions on proposal format.

Responses shall begin with a letter of interest from the principal firm, followed by an Executive Summary of not more than five pages that addresses the Evaluation Criteria and Scope of Work shown in Attachment A. Responses shall include an organizational chart for preconstruction and construction phase services. Response may include such other information and details to support the firm's qualifications to perform this work.

Qualifications submittals will be received until the time and date shown in the Schedule of Events (Section II f). Such qualifications submittals must be typed on standard (8 ½" x 11") paper. The pages of the qualifications submittals must be numbered. A table of contents, with corresponding tabs, must be included as well, to identify each section. Qualifications submittals must meet the requirements of and conform to the "Qualifications Submission Format and Requirements," as stated in Section III of this RFQ.

Evaluation of these qualifications submittals will be performed by the [insert Agency], the Architect, and the Georgia State Financing & Investment Commission (Selection Committee). Proposals shall be submitted to:

Georgia State Financing & Investment Commission
Suite 1002, West Tower, Floyd Building
2 Martin Luther King Jr Drive
Atlanta, Georgia 30334
Attn: Mrs. Angela Gunter

Except for submission of questions, discussed further below, proposers shall not contact any members, or employees, of the Georgia State Financing & Investment Commission, [insert Agency], or the Architect regarding any aspect of this procurement, until after the award of the contract. Contact with the above-mentioned individuals could be grounds for elimination.

No qualifications submittals will be accepted after the time set for receipt of the qualifications submittals. Qualifications submitted via facsimile, telegram, or mailgram will be rejected.

It is the responsibility of each proposer to examine the entire RFQ, seek clarification in writing, and review its qualifications submittal for accuracy before submitting the document. Once the submission deadline has passed, all qualifications submissions will be final. The Owner will not request clarification from any individual proposer relative to their qualifications submission, but reserves the right to ask for additional information from all parties that have submitted qualifications.

It is the Owner's intent to limit the cost to proposers incurred by responding to this solicitation, so you are encouraged to be brief and succinct. The reviewers will not appreciate thick volumes of

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

background and general marketing material, nor will such curry their favor. We are seeking thoughtful, tightly focused qualifications submittals that document your firm's suitability for this Project and understanding of the Project and Owner. Each firm must describe experience. If there are multiple firms proposed as one team, please indicate, by firm, those qualifying as a minority firm.

2. Request for Proposals

Within sixty (60) days of the receipt of the qualifications submittals, three to five firms judged to be most qualified, based on the information provided in the qualifications submittal, will be asked to submit information that is more detailed concerning their experience and abilities, attend an interview with the selection committee, and submit a proposal for fees and general conditions. The deadline for the submission of the additional information will be contained in the notice identifying the shortlisted firms, but will be no more than twenty-one (21) days after the notice and no less than fourteen (days) after the notice.

The Georgia State Financing & Investment Commission reserves the right to negotiate, prior to award, adjustments in any and all elements of what proposers submit in their proposals so long as such adjustments do not have the affect of increasing the total compensation paid by the Owner over the total proposed compensation set forth in submitted proposals.

Where the RFP requires the proposer to submit a number of days, or to submit a milestones chart, the days used shall be calendar days unless otherwise specified herein.

Any submitted proposal shall remain valid for six months after the proposal due date or until the Owner executes a contract, whichever is sooner. In the event the selected proposer fails to perform and/or the contract is terminated within forty-five days of its initiation, GSFIC may ask the submitter of the next acceptable proposal to honor its proposal.

Questions relating to the RFQ or RFP may be asked at the Preproposal Conference. Any other questions must be submitted in writing to:

Georgia State Financing & Investment Commission
Suite 1002, West Tower, Floyd Building
2 Martin Luther King Jr Drive
Atlanta, Georgia 30334
Attn: [\[insert name\]](#)

or faxed to (404) 656-6009

The deadline for submission of questions relating to the RFQ is the time and date shown in the Schedule of Events (Section II f). All questions from the preproposal conference as well as any questions, which have been submitted in writing, prior to the deadline, will be compiled and answered in writing. A copy of all questions and answers will be sent only to those firms who attended the preproposal conference.

E. Information Regarding Scope of Work during Phases of Project

The building Commissioning services scope of work for this project is found in Attachment A to this RFP.

The Architect shall retain all normal architectural responsibilities for professional design, cost control, schedule and quality assurance including normal construction administration responsibilities.

F. Schedule of Events

The following Schedule of Events represents the Commission's best estimate of the schedule that will be followed. Unless otherwise specified, the time of the day for the following events shall be between 8:00 a.m. and 4:30 p.m. Eastern Time. The Commission reserves the right, at its sole discretion, to

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

adjust this schedule, as it deems necessary. Notification of any adjust to the Schedule of Events shall be provided to all Proposers attending the Preproposal meeting.

EVENT	DATE	TIME
1. GSFIC issues advertisement	date	time
2. Deadline for written questions and clarification request on RFQ	date	time
3. Preproposal Conference	date	time
4. Deadline for submission of Initial Qualifications	date	time
5. GSFIC completes initial qualifications evaluation and issues shortlist	date	time
6. Deadline for shortlisted firms to submit detailed qualifications	date	time
7. GSFIC interviews shortlisted firms	date	time

III. Qualifications and Proposal Submission Format and Requirements

A. Request for Qualifications

Five (5) copies of the qualifications shall be submitted. Each submittal shall be identical and include a transmittal letter. Proposers are encouraged to follow the sequence of the request for qualifications in their responses. Responses should be concise, clear, and relevant. Proposers' costs incurred in responding to this request for qualifications are proposers' alone and the Owner does not accept liability for any such costs.

The qualifications submittal should contain the following information in the following order:

1. Basic Company Information
 - Company name
 - Address
 - Zip code
 - Telephone number
 - Fax number
 - E-mail address
 - Name of primary contact
 - Number of years in business
2. Form of Ownership, Including State of Residency or Incorporation

The offeror must disclose its form of ownership, whether sole proprietorship, partnership, corporation, limited liability company, or some other structure. Firms contemplating a joint venture should submit separate qualifications unless the joint venture entity has completed at least **TWO** relevant projects.
3. Office Submitting Qualifications

If the firm has multiple offices, the qualifications statement should include information about the parent company and branch office separately.
4. Firm's Background (15 Points)

Background statements should include general business qualifications, including brief background and history of firm, organization, location of the proposer's home office and other pertinent offices, and corporate staffing, describing the composition of staff in each office. The proposer must demonstrate depth of experience in its personnel and its capability to sustain loss of assigned

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

personnel without compromising quality and timeliness of performance. Background statements should provide general information about the firm's personnel resources, including classifications and numbers of employees and locations and staffing of offices. Statements should provide details on company qualifications in response to requirements noted in paragraph 1.D. of this solicitation.

5. **Key Staff Experience (20 Points)**

List the key individuals who will be the CxA team for this contract and provide resumes for each person describing their relevant qualifications and experience. Provide an organizational chart indicating project management and supporting staff for each phase of the project. The contract will require that this team be committed to the project for its duration. Information that is more detailed should be included for key personnel expected to be involved on the project. Where the project schedule plans for a construction start later than six months from date of the solicitation, the proposer may provide multiple names. Each resume should include an Owner and design professional reference. Provide details on staff qualifications in response to requirements noted in paragraphs 1.D. of this solicitation.

6. **Technical Experience (20 Points)**

Proposers shall provide project technical experience descriptions of three recently (within the last 5 years) completed building Commissioning projects, for which the proposer was the principal CxA. The detailed project descriptions shall include type of facility, description of project with square footage and systems commissioned, and the scope of Commissioning that the proposer provided. Also, provide the name, address, telephone number, and FAX number of the Owner's project manager. Provide details on experience qualifications in response to requirements noted in paragraph 1.d. of this solicitation.

7. **Experience in Project Delivery System and Project Type (20 Points)**

Provide examples of specific project experience utilizing the anticipated form of procurement, including experience relevant to the type of project to be constructed. Describe no less than two and no more than five roughly equivalent projects (similar type of construction and a contract dollar amount equal to 75% or more of the incumbent project) that demonstrate the firm's capabilities to perform the project at hand. For each project, the following information should be provided:

- Project name
- Project location
- Dates during which services were performed
- Physical description (e.g., square footage, number of stories, site area) Brief description of project
- Services performed by CxA/GC firm
- Statement of performance versus Owner expectations in the areas of costs, quality, and schedule
- Owner reference
- Design professional reference

In addition, provide a list of CxA projects currently in progress or completed by the Commissioning Project Manager in the last 5 years.

8. **Statement of Why the Proposing Firm should be Selected (15 Points)**

This section provides each firm the opportunity to provide specific information that differentiates them from others in the competition. This statement should be limited to two pages.

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

Major Category	Criteria
Quality of Submittal (10 Points)	<ul style="list-style-type: none">• Extent to which the instruction in the RFQ were followed
Firm Background (15 Points)	<ul style="list-style-type: none">• Experience and capacity of the firm• Experience in project delivery system and project type
Key Staff Experience (20 Points)	<ul style="list-style-type: none">• Experience and ability of proposed staff
Technical Experience (20 Points)	<ul style="list-style-type: none">• Number and complexity of CxA projects completed by firm
Experience in Project Delivery System and Project Type (20 Points)	<ul style="list-style-type: none">• Project experience utilizing the form of procurement & type of project• Number of CxA projects completed by Project Manager
Statement of Why the Firm Should be Selected (15 Points)	<ul style="list-style-type: none">• Quality of response

B. Request for Proposals

The selection committee will review the data submitted above and select three to five firms. These firms will be asked to submit the following detailed information in the following order. Five (5) copies of the information shall be submitted, each in a single three (3) ring binder. Each binder shall be identical and include a transmittal letter. Binders shall be submitted in a cardboard box. Responses should be concise, clear, and relevant. Proposers' costs incurred in responding to this request for qualifications are proposers' alone and the Owner does not accept liability for any such costs. Following completion of the initial evaluations, the firm will be granted an opportunity to appear before the Selection Committee to make a presentation and to submit to an interview. The time allotted to each firm for the presentation and interview shall not exceed forty-five minutes.

To be considered, prospective proposers must submit a complete response as required herein. Proposers must submit evidence of their abilities and provide complete, thorough, and comprehensive responses and information for each of the following components of the RFP. Proposers must submit (1) original plus (4) copies of the proposal.

1. Firm's Ability (15 Points)

Firm Description and Letter of Interest (maximum 4 pages)

- a) Describe the history and growth of your firm(s) as succinctly as possible.
- b) Describe your experience with litigation with Owners, Subcontractors, and Architects. List any active or pending litigation and explain.
- c) Has the firm been involved in any litigation in the past five (5) years?
- d) List at least five Architect and Owner references for projects that your firm has completed in the past three years. Briefly describe the projects and list the company, contact person, and phone number.
- e) List five (5) major trade contractor references (company, contact, and phone number).
- f) Provide company organizational chart.
- g) Provide a statement of disclosure, which will allow the Owner to evaluate possible conflicts of interest.

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

2. Financial Responsibility
 - a) List your total annual billings for each of the past 3 calendar years.
 - b) Supply financial references.
 - c) List main banking references
 - d) Has the firm ever failed to complete any work awarded to it, or been removed from any project awarded to the firm?
 - e) What is the firm's annual volume and average volume the past three (3) years?
 - f) List the contact persons, addresses, and phone numbers for your insurance carrier and agent.
 - g) What percentage of your firm's work has been negotiated during the past three (3) years?
3. Experience (10 Points)
 - a) Provide for each of the examples of your experience as Commissioning Authority for facilities similar to this project which were included in your response to the RFQ the following information:
 - (1) Provide an owner reference familiar with your performance on the project. It is the proposer's responsibility to ensure that you have listed a current contact with a correct phone number.
 - (2) Provide a design professional reference (with current phone number) familiar with your performance on each project.
 - b) Indicate those projects that included Architect, Engineering consultant, Commissioning Authority and contractor serving a corporate or public client *as a team*.
 - c) Provide the two most recent projects your firm has completed. For each project, provide the name of an owner's representative (with a current phone number) who is familiar with your performance on the project.
 - d) Provide any additional relevant information.
 - e) As an attachment, proposers shall provide an example of the following work products that members of the proposer's team wrote. List the team member who actually wrote the document and the projects on which they were used.
 - (1) construction Commissioning Plan
 - (2) sample mechanical Commissioning specification
 - (3) actual functional test procedure form that was executed
4. Management Plan (20 Points)
 - a) Describe your firm's proposed organization for the Commissioning team including principals, project directors, project managers, etc. who will manage the project.
 - b) Please provide for each of the above personnel:
 - (1) Current resumes listing relevant project experience.
 - (2) Percent of time to be committed to this Project.
 - c) Please identify the individual who, *from project start to finish*, will be the leader of your team and the principal point of contact between your firm and the Owner, the Architect, and other consultants. This individual's competence, his leadership, and his ability to achieve *customer satisfaction* will be heavily considered in the selection of a CxA.
5. Services (5 Points)
 - a) Provide one page overview of services typically performed for similar projects using Commissioning.
 - b) How would you implement these services to ensure the success of this project?
 - c) Describe your firm's approach to providing preconstruction services.
 - d) Describe your approach to working with GSFIC.

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

6. *Schedule (5 Points)*
 - a) Describe your general approach to the schedule for this project.
 - b) Describe your firm's scheduling systems and explain how your firm intends to manage the preconstruction phase schedule for Commissioning services.
 - c) Describe your firm's scheduling systems and explain how the firm intends to manage the construction phase schedule for Commissioning services.
 - d) Describe alternatives that may be explored to shorten the schedule.
 - e) Describe how you will integrate the Commissioning services schedule with the overall project schedule.
7. *Commissioning Approach (15 Points)*

Proposers must provide a comprehensive narrative captioned "Project Understanding" that illustrates the Proposer's understanding of *[insert Agency]*'s requirements. Proposers must provide a comprehensive narrative captioned "Project Approach" that describes your approach to managing the project, including your team's participation. Describe what approach you will take to integrate Commissioning into the normal design and construction process in order to minimize potential time delays. Describe what you will do to foster teamwork and cooperation from contractors and Designers and what you will do to minimize adversarial relationships. Describe how you intend to determine the appropriate level of Commissioning effort for the various systems and equipment.
8. *Other (5 Points)*

MWBW Participation and Nondiscrimination.

 - a) Please include your firm's affirmative action policy, as well as your proposed efforts to ensure minority participation on this project.
 - b) State your firm's history of Minority and Women-Owned Business (M/WBE) participation.
 - c) State your plan for including M/WBE participation in this project including development of bid packages and your goal for participation.
 - d) List references of Owners, M/WBE firms or consultants who can speak to your firm's utilization of M/WBE on previous projects.
9. *Fee Proposal*
 - a) Each firm selected for further consideration shall be notified in writing and informed of a place and time for the interview session. The Commissioning selection committee shall interview the selected firms for no more than one hour, including the time for questions and discussion with the proposer. The format of the interview session is at the discretion of the proposer.
 - b) The proposer shall deliver a "Cost Proposal," which is to execute building Commissioning for the design phase period only. At the 95% completion of construction documents phase, the proposer shall enter negotiations for the Commissioning effort required during the construction, acceptance, and warranty periods. The outcome of those negotiations shall determine the final effort of the CxA during the other phases.

IV. General CxA Selection Criteria

The services sought under this RFP are considered professional in nature. Consequently, the evaluation of the proposals will be based upon consideration of the demonstrated qualifications and capabilities of the proposers that will result in an award that is in the best interest of GSFIC. Absent written notice to the shortlisted firms affected, factors to be considered in the evaluation shall be limited to the following (next page):

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

Major Category	Criteria
Firm's Ability (15 Points)	?Overall strength relative to the proposed project ?Financial stability ?Past ability to work as a team with Architects and Program Managers ?Firm's "management" philosophy/plan for administering the work ?Firm's current and projected workload ?Number and qualifications of professional and support personnel available to work on this project
Experience (10 Points)	?Firm experience with similar projects ?Assigned team's experience with projects of similar facility size ?Assigned team's experience with innovative budget control ?Assigned team's experience with innovative schedule control ?Quality of references
Management Plan (20 Points)	?Strength of team assigned relative to proposed project and facility size ?Project executive and superintendents ability to work as a team ?General approach to proposed project ?Approach to project close out
Services (5 Points)	?How well services address proposed project
Schedule (5 Points)	?Ability to provide schedule control
Commissioning Approach (15 Points)	?Approach to project Commissioning
Other (5 Points)	?Firm's affirmative action plan concerning its work force and procurement practices ?Firm's record on policies of nondiscrimination on the basis of race, creed, color, sex, or national origin in its employment or procurement practices
Interview (25 Points)	?Overall impression of project manager ?Overall impression of site supervisor(s) ?Methodology presented to assure success ?Ability of principals to engender confidence in the ability of the firm ?Ability of team members to communicate during the interview process ?Overall impression of the firm

Upon completion of the evaluation process by the Selection Committee, the firms will be ranked in descending order of recommendation. Negotiations will then be initiated with the best-qualified firm. In the event a satisfactory fixed fee cannot be reached with the highest ranking firm, the Owner will formally terminate the negotiations in writing and enter into negotiations in turn with the second ranking firm or the third ranking firm until a mutually agreed upon fixed fee is established. Once the successful CxA and the agreed upon fixed fee have been determined, a CxA services contract will be awarded by the Georgia State Financing & Investment Commission. The Form of Contract shall be a modified Contract developed by the Owner. A copy of the proposed contract will be made available to each of the shortlisted firms prior to the time set for their interview.

V. Additional Conditions

- The Owner reserves the right to reject any or all Proposals received. The Owner is not obligated to request clarifications or additional information but may do so at the Owner's discretion. The Owner reserves the right to extend the deadline for submittals.
- Confidentiality of Documents. Upon receipt of a proposal by the Owner, the proposal shall become the property of the Owner, without compensation to the proponent, for disposition or usage by GSFIC or the Using Agency at their discretion. Subject to the provisions of the Open Records Act, the details of the proposal documents will remain confidential until final award.

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

- Costs to Prepare Responses. The Owner assumes no responsibility or obligation to the respondents and will make no payment for any costs associated with the preparation or submission of the proposals.
- Equal Employment Opportunity. During the performance of this Contract, the Commissioning Authority agrees as follows: The Commissioning Authority will not discriminate against any employee or applicant for employment because of race, creed, color, sex, age, national origin, place of birth, or physical handicap. The Commissioning Authority must have a history of being non-discriminating and will not discriminate based on race, creed, color, sex, or national origin in any of the CxA's employment practices, or procurement practices with respect to the work force of the firm, or procurement services in connection with this project. An affirmative action plan must be maintained for both work force and procurement practices.
- GSFIC does not desire to enter into joint-venture agreements with multiple Commissioning firms. In the event two or more firms desire to "joint-venture," GSFIC strongly recommends that one incorporated firm become the Program Management firm with the remaining firm(s) being consultants.
- The Commissioning Selection Committee desires to review information on the Commissioning firm and major consultants. The firm is requested to name principal consultants and submit Statements of Qualifications and Performance Data accordingly, including therein all of the information requested of the firm (including, for example, a statement of efforts that have been or will be made to encourage and solicit participation by qualified minorities).

**ATTACHMENT A
SCOPE OF WORK**

1.0 General

The [\[insert Agency\]](#) is committed to Commissioning this facility to ensure that all systems are complete and functioning properly prior to substantial completion and that facility staff have adequate system documentation and training.

The Commissioning process shall oversee and coordinate the traditionally separate functions of equipment startup, system performance testing and balancing, control system calibration,, construction and system documentation, and training.

Specific requirements of the Commissioning process and responsibilities, duties, and obligations of the Commissioning Authority (CxA) team are described in Section 2, Commissioning Tasks. To accomplish these tasks, the CxA shall be required to coordinate his or her activities with other entities. The specific responsibilities of the mechanical contractor and his or her associated subcontractors are defined in Division 15, and those of the electrical contractor and his or her associated subcontractors in Division 16 of the contract documents. The Commissioning process does not take away from or reduce the responsibility of the project Designers or installing contractor to provide a finished and fully functioning product. It is noted that the services of the Georgia State Financing and Investment Commission (GSFIC) Project Manager (PM), Design Team, and the Constructor (C) and various subcontractors, are NOT provided for under this Scope of Work and the CxA is not responsible for providing their services.

The primary role of the CxA shall be to develop and coordinate the execution of a Commissioning Plan; observe and document the installation, checkout, startup, and equipment and system testing to establish that equipment and systems are functioning in accordance with the requirements of the contract documents; and to assist the [\[insert Agency\]](#) in developing correct and complete documentation of the construction effort. The CxA will not be responsible for design concept, design criteria, compliance with codes, design, or general construction scheduling, cost estimating, construction management, or construction supervision. The CxA may assist the Design Team with design issues, problem solving, or the correction of construction non-conformance or deficiencies, but ultimate responsibility for meeting the project objectives and requirements resides with the A/E team and Constructor.

2.0 Commissioning Tasks

The following tasks will be accomplished by the CxA to provide Commissioning during the design, construction, acceptance, and warranty phases of the project.

2.1 Systems to Commission

Specific systems that shall be commissioned include:

- Building automation systems, including linkages to remote monitoring and control sites.
- Chillers, pumps, piping, cooling towers, and associated equipment.
- Boilers, pumps, piping, and associated equipment.
- Air Handling Units.
- Exhaust fans.
- Terminal units.
- Unit heaters and unit ventilators.
- Heat exchangers.
- Computer room A/C units.
- HVAC and laboratory control systems.

- Plumbing systems.
- Fire protection systems.
- Service water heaters, pumps, and associated equipment.
- Laboratory compressed air and vacuum system equipment.
- Emergency power and uninterruptible power supply (UPS) system.
- Utility metering systems.
- Smoke control systems – interfaces, egress pressurization.
- Fire alarm systems.
- Security, access control, and CCTV systems.
- Lighting control systems.
- Voice/data communications systems.
- Public address systems.
- Power distribution system.
- Electrical system from the building entrance through the main switchboard, switchgear, and to the distribution panels.
- **[Insert other systems].**

2.2 Design Phase

The CxA shall complete the following tasks during the design phase:

- Coordinate and supervise the Commissioning work during design.
- Prepare and distribute the design phase Commissioning Plan.
- Attend initial meetings with **[insert date]** and Design Team to discuss role of CxA, and coordination of design.
- Obtain the **[insert Agency]** “Design Intent” information and the “Basis of Design” information from the owner and Design Team.
- Provide design and Constructor Team members with Commissioning items to be considered during design.
- Perform a focused design review at the end of design development, 50% and 95% design stages, which shall include the following: a) input regarding making the building easier to commission; b) how building O&M can be made easier (accessibility and system control, etc.); and c) how utility usage and Indoor Environmental Quality can be improved.
- Prepare Commissioning specifications for the construction bid documents for all systems and equipment that are to be commissioned.
- Have the Commissioning specifications approved by the A/E team and included in the A/E construction specifications.
- Prepare draft functional tests for equipment and systems to include in specifications.
- Submit test procedures to Design Team for review and comments.
- Attend three-Design Team review meeting to discuss comments on plans and coordinate specifications.
- Review bids and contractor pricing regarding Commissioning activities and submit evaluations to the **[insert Agency]**.

It is assumed that the A/E will provide adequate written Design Intent, Basis of Design, and full sequences of operations, complete with points lists and control schematics for all equipment and systems for inclusion in the O&M manuals and for the CxA to use in writing functional tests.

2.3 Construction Phase

The CxA shall complete the following tasks during the construction phase:

- Conduct a partnering meeting with the Constructor Team to discuss Commissioning scope, plan, and schedule.
- Coordinate the Commissioning work and, with the Constructor (C) and construction manager (CM), ensure that Commissioning activities are being scheduled into the master schedule.
- Continue to update schedule and coordination throughout construction with GC and subcontractors.
- Submit final Commissioning Plan for construction with coordination and activities for **[insert Agency]** and GC review.
- Review and approve normal contractor submittals applicable to systems being commissioned for compliance with Commissioning needs, concurrent with the A/E reviews.
- Ensure that O&M material is submitted to the CxA team as the contractor receives it. This material will be needed to assist in finalizing startup and testing procedures.
- Prepare final pre-functional and final functional test procedures for the equipment and systems.
- Submit test procedures to contractor for comments on appropriate startup, operations, and systems safety.
- Coordinate with the contractor to witness startup of major equipment.
- Review and approve TAB execution plan.
- Perform monthly site inspection during rough-in of systems and equipment.
- Maintain a deficiency log of any items found to be a problem, poorly installed, or discrepancies.
- Attend up to **[insert quantity]** on-site meetings for review of progress, coordination, and issues resolution. More than **[insert quantity]** on-site meetings will be considered work outside the normal scope of work.
- Witness a sample of pipe test and flushing procedure, sufficient to be confident that proper procedures were followed.
- Witness a sample of any ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed.
- Witness a sample of checkout, TAB, end-to-end testing, and calibration of controls.
- Observe first pre-functional test of each type of system, including mechanical, controls, electrical, and specialty systems.

2.4 Acceptance Phase

The CxA shall complete the following tasks during the acceptance phase:

- Continue to update schedule and coordination throughout construction with GC and subcontractors.
- Obtain pre-functional reports from Constructor with sign-offs that the systems have been checked out.
- Oversee TAB, including 25% check of diffusers, grilles, hoods, terminal devices, and equipment testing, and document findings.
- Witness performance testing of smoke control systems.
- Witness functional testing of each major piece of equipment to demonstrate that each item of equipment and system is operating according to the Design Intent and contract documents. Functional testing shall include operating the system and components through each of the written sequences of operation. Test on respective HVAC equipment shall be executed during both heating and cooling seasons.

APPENDIX A, continued
Sample RFQ/RFP for Independent Commissioning Services

- Provide troubleshooting to assist in resolving control problems, as they are uncovered. Functional testing shall be performed on all control points.
- Check system graphics to assure all graphics are developed and points are mapped to graphics.
- Keep a detailed log of testing of each piece of equipment.
- Maintain a deficiency log of any items found to be a problem, poorly installed, or discrepancies. Provide the log and test results to the owner, CM, and GC with recommended actions.
- Coordinate retesting as necessary. One retest will be provided as part of normal checkout. More than one retest will be considered work outside the normal scope of work.
- Notify the owner and GC of the unacceptable findings if 10% of identical pieces of equipment fail to perform to the requirements of the contract documents due to manufacturing defects not allowing it to meet its submitted performance spec, and request explanation of problem and proposed solution from the GC; then review the proposed solutions.
- Attend weekly meetings while on-site for functional testing.
- Attend up to *[insert quantity]* additional on-site meetings for review of progress, coordination, and issues resolution. More than *[insert quantity]* on-site meetings will be considered work outside the normal scope of work.
- Review O&M documentation for completeness. This review shall be in parallel with the A/E team's review of the O&M documentation for conformance to the project specification.
- Provide the user staff with a one-day systems training on "how the building is supposed to operate."
- Review, pre-approve, and coordinating training of the *[insert Agency]* operating personnel by the contractor.
- Perform seasonal testing checkout of equipment, September for cooling system and January for heating systems.
- Prepare three copies of the Commissioning management report (Commissioning Final Report). The report shall include an executive summary, list of participants and roles, brief building description, and the following sections:
 - a. Design Intent
 - b. Basis of design
 - c. Pre-functional checklists complete
 - d. Functional checklists complete
 - e. TAB reports
 - f. System schematics
 - g. Control strategies and set points
 - h. Deficiency Log
 - i. Guidelines for energy accounting

2.5 Warranty Phase

The CxA shall complete the following tasks during the warranty phase:

- Return to the site quarterly and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal Commissioning.
- Interview facility staff and identify problems or concerns they have with operating the building as originally intended.
- Identify deficiencies that may come under warranty or under the original construction contract.
- Provide one day of additional training for users and staff in building system operations.
- Prepare a detailed evaluation after ten months on the status of warranty issues for the [\[insert Agency\]](#).
- Attend up to four on-site meetings—in addition to the quarterly site reviews—to discuss warranty issues.

2.6 Systems and Equipment Not Included in Commissioning:

- [\[Insert systems\]](#)

3.0 Schedule

The project design and construction is scheduled as follows:

Schematic design	[insert date]
Design development documents	[insert date]
30% design	[insert date]
60% design	[insert date]
90% design	[insert date]
Construction documents	[insert date]
Bid date	[insert date]
Award date	[insert date]
Construction notice to proceed	[insert date]
Final Commissioning & punch list	[insert date]
Beneficial Occupancy	[insert date]

4.0 Test Equipment

The installing contractors shall provide all tools or the use of tools required to start, checkout, and functionally test equipment and systems, except for specified testing with supplemental portable dataloggers, which shall be supplied and installed by the CxA.

To expedite air-water balance testing, and to minimize additional cost to the contractor, the CxA will verify the TAB contractor's air-water balance values, using their own engineers, field technicians, and test equipment.

Datalogging equipment, monitoring devices, specialized equipment, and software not required to be provided by the installing contractor in the contract documents, and provided by the CxA to monitor, confirm, or verify the contractor's testing procedures, shall remain the property of the CxA. Equipment provided shall meet the minimum accuracy, calibration, and performance standards required by the performance test.

**ATTACHMENT B
PREDESIGN REPORT**

The *[insert name]* project is a *[insert short description of the facility to be commissioned]*.

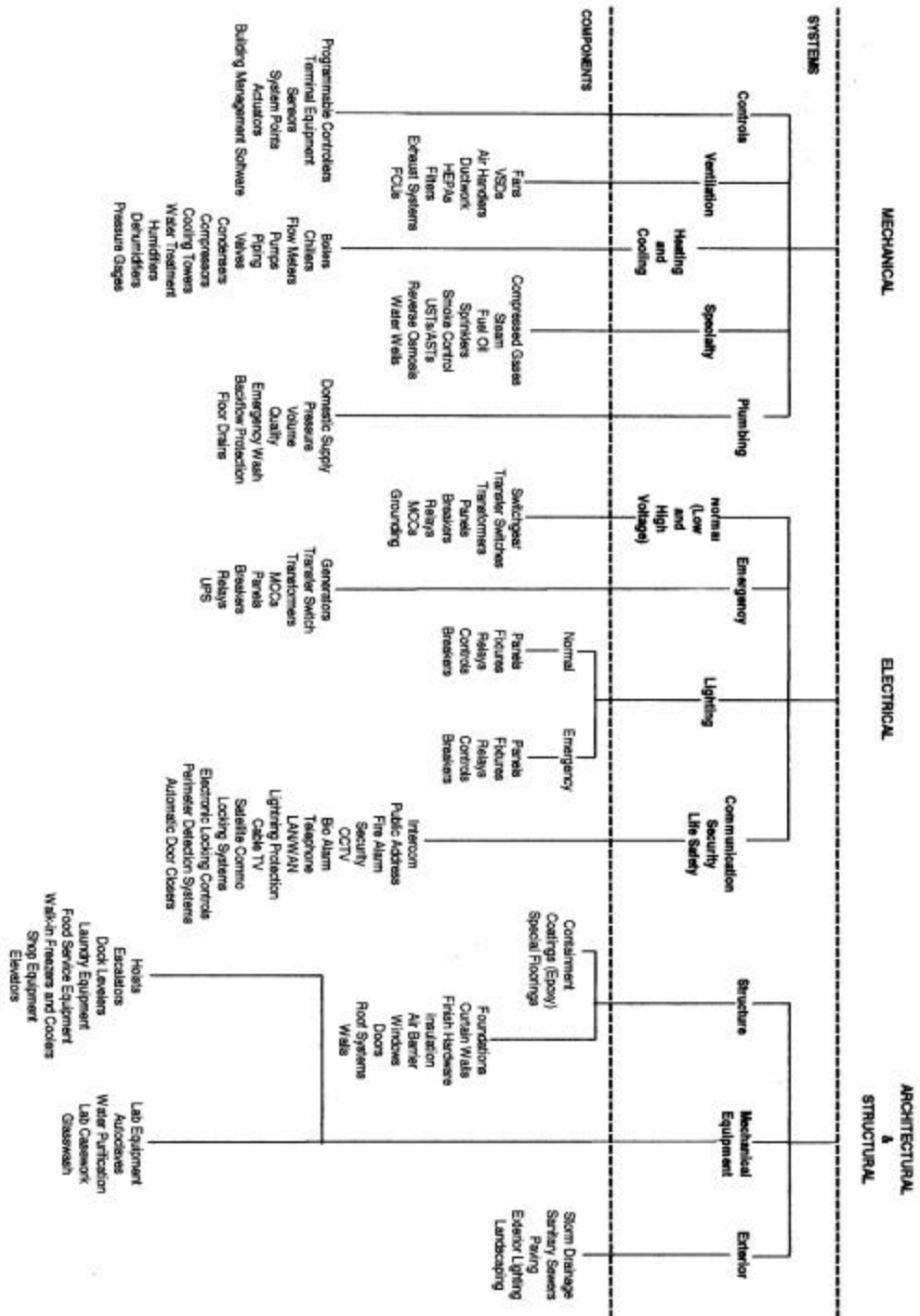
The project has gone through the predesign phase, with a predesign report prepared by *[insert name of A/E firm]*. A copy of the predesign report is attached for review.

[Insert copy of predesign report.]

APPENDIX B
Guiding Documents for the Commissioning Process

Document	Stage of Commissioning	Performed By
Design Intent Narrative	Predesign	Consulting Architect/Planning Team
Owner's Quality Assurance Procedure	Predesign/Early Design	Owner's Project Manager
Preliminary Commissioning Plan	Design Specifications	Commissioning Authority
Commissioning Plan	Early Construction	Commissioning Authority
Inspection and Functional Performance Test Forms	Acceptance	Commissioning Authority
Commissioning Final Report	Completion	Commissioning Authority

APPENDIX C Modern Building Systems



What is a Design Intent?

A Design Intent is a document that defines the building Owner's expectations and goals for a building. The Design Intent is the basis for evaluating whether or not the design and construction of the building will be satisfactory to the Owner. Proposed changes and deviations from the original design must be weighed against the Design Intent. The Design Intent is a "living" document in that it is updated and revised throughout the design and construction process based upon the decisions made along the way.

The purpose of the Design Intent is to provide clear documentation of the Owner's requirements for a successful project, for communication to all parties involved in the project. Therefore, it should be written in non-technical language, and avoid the use of terminology that may be specific to only one group of people. It should be understandable by everyone involved in the project, including the Owner, maintenance staff, Constructor Team, Architect, Engineers, and equipment manufacturers

The reason that a Design Intent document is required, regardless of the project stage when starting Commissioning, is that the Design Intent sets forth the goals and criteria against which the success of the project is to be evaluated.

No single format is required for use to document a Design Intent because of the variation in different Owners' requirements for a successful building, the type of building being constructed, and the writing style of the person creating the Design Intent document.

However, the information in the Design Intent is usually presented from general to specific. Items such as background on the building, a description of Commissioning, functional uses of the spaces in the building, and general goals for the building are presented first. Information that is more detailed, such as measurable values to test or obtain during design, (e.g., lighting levels, energy savings, and reduced occupant complaints), is then presented.

A possible Design Intent format list is shown below as an example.

1. General Project Description
2. Objectives
3. Functional Uses
4. General Quality of Materials and Construction
5. Occupancy Requirements
6. Indoor Environmental Quality Requirements
7. Performance Criteria
8. Budget Considerations and Limitations

This list of one possible format for a Design Intent begins with a general project description to familiarize the reader with the size, features, and history of the building that is to be constructed. The objectives that are to be met during design and construction are listed second.

Next, the functional uses of the buildings are listed, which are the general types of usable spaces, that will be present in the building. Examples include cafeteria, closed office space, open office space (partitions), classrooms, and computer rooms. Each functional use area generally requires distinct building features, systems and equipment in order to be able to perform the intended tasks.

The general quality of materials and construction required for the project are then described. Typically, this description includes a specific quality requirement for a specific type for equipment, material, or construction. An example might be a requirement that all HVAC

equipment shall have a lifespan not less than 20 years, or there shall be no Constructor callbacks due to defective materials/construction for a period of 5 years.

Occupancy requirements are listed next, to include the intended number of people and the occupancy schedule for each functional use area. Indoor Environmental Quality requirements, such as lighting levels, noise levels, temperature and humidity requirements, and ventilation requirements for each functional use area, would be also included.

Performance criteria for the various building systems and equipment are included next. These criteria are used to select the types of equipment systems for the building during the design stage, and are used in the turnover stage to develop the Functional Performance Test procedures.

Finally, budget considerations and limitations are included. While building Owners would like to receive the best possible building they can get, they are nearly always bound by budget limitations.

The Design Intent should be as specific as possible to provide clear direction to Designers and Constructors in effort to eliminate the need on their part to guess or interpret an Owner's requirements. For example, instead of only stating that comfort in the space shall be maintained, the Design Intent should provide a definition of what the Owner considers comfort to be, such as specific temperature, humidity, and noise level. In addition, there must be some way to verify the content of the Design Intent. In order to do so, a specific value, or range of values, that is acceptable and testable, should be included. For example, an area specified to be "quiet" cannot be verified because of subjective interpretations of quiet. However, an area specified to be below 35NC when occupied can be tested and verified. Note the difference in the example below.

Typical Statement:

Comfort in space shall be maintained.

Contrast that with the Design Intent content, would should read (with blanks filled):

Comfort in the space shall be maintained; Owner defines comfort as:

- Temperature of _____
- Humidity of _____
- Airflow of _____
- Noise < _____
- No glare

Design Intent Document

This narrative is developed directly from the Owner's program information. This narrative is prepared almost entirely by the project Architect and contains "performance" criteria as opposed to design solutions (although tentative design solutions may need to be identified in the course of verifying the budget).

- Function of Structure
- Location
- Utilities
- Life Expectancy
- Level of Quality
- Size and/or Population
- Functional Floor Plan
- Environmental system requirements by area:
 - Temperature
 - Humidity
 - Fume Control
 - Particulates
 - Illumination
 - Noise
 - Vibration
 - Acoustics
- O&M Access
- Energy efficiency
- Reliability of environmental systems-redundancy
- Emergency systems
- Life safety criteria
- Special design concerns
- Special O&M concerns
- Budget

APPENDIX E

Basis of Design Document

Follows directly from the Design Intent Document and identifies technical and operational methods of satisfying the Design Intent. Includes:

Weather conditions

System selection

- HVAC
- Utility systems
- Lighting
- Life safety
- Emergency
- Code requirements
- Owner requirements
- Industry requirements

Confirmation of Feasibility

- Temperature
- Humidity
- Particulates
- Noise
- Vibration
- Lighting
- Budget

Special Systems

- Pure water
- Lab gas
- Fume control
- Pressurization

APPENDIX F
Sample Preventive Operation Plan

Task Description	Frequency
Fans (Discharge, Return, Exhaust, etc.)	
Measure and record whether fan RPMs are correct (according to design)	Semi-annually
Filters	
In addition to the maintenance issue of condition, check type and direction	Monthly
All Dampers (Return, Exhaust, Outside, Air, Mixing, etc.)	
Tighten and adjust damper blades and linkages	Semi-annually
Check that damper blade seals are in good repair and verify that dampers close tightly (face & bypass and hot & cold deck semi-annually, others annually)	Semi-annually
Check that all actuators and linkages function properly	Quarterly
Heating and Preheat Coils	
Check heating valve for proper function (stroke valve open and closed)	Monthly
During heating season, measure and record the difference in temperature between the entering heating water and leaving heating water at the heating coil	Quarterly
During heating season, check heating coil valve for leakage. Measure and record change in temperature across the heating water coil after the coil valve has been closed for several hours	Annually
Cooling Coil	
Check the cooling valve for proper function (stroke valve open and closed)	Monthly
During the cooling season, measure and record the difference in temperature between the entering chilled water and leaving chilled water at the cooling coil	Quarterly
During cooling season, check cooling coil valve for leakage. Measure and record change in temperature across the chilled water coil after the coil valve has been closed for several hours	Annually
Temperature Controls	
Check that all set points are correct per conservation requirements, design, or Owner's needs	Quarterly
Check that sensors are secure	Annually
Check and calibrate all temperature space sensors associated with unit	Annually
Check and calibrate all air handler sensors (discharge air, mixed air, outside air, etc.)	Semi-annually
Check that setback and setup temperature set points are correct	Quarterly
Check that reset schedules such as supply air, chilled water and heating water are correct	Quarterly
Check comfort levels in space, both dry bulb temperature and relative humidity, with manual instruments	Quarterly
Check that all deadbands are correct (no simultaneous heating and cooling unless by design)	Quarterly

APPENDIX F
Sample Preventive Operation Plan

Basic Control Strategies	
Check that time-of-day (TOD) and holiday schedules are correct according to owner or occupant's requirements	Weekly
Check that optimum-start and coast-down strategies are working correctly	Quarterly
Check that morning warm-up, night-purge, and pre-cool strategies are working correctly	Quarterly
Check that soft-start strategies are functioning properly to reduce peak	Quarterly
Check that economizer is controlled to take advantage of free-cooling using outside air	Semi-annually
Check that all related pneumatic receiver controllers and transducers are operating properly	Semi-annually
Check minimum outside air delivery	Semi-annually
Calibrate pneumatic receiver controllers	Annually
General	
Check for presence of space heaters, open windows, covered diffusers, and personal fans as an indicator of a possible equipment operational and thermal comfort problem	Semi-annually
Check for presence of microbial growth on walls or ceiling tiles, wet carpets, and musty smells as an indicator of an operational problem that may cause inadequate Indoor Environmental Quality	Semi-annually
Verify that outside air intakes are not receiving contaminated air	Semi-annually

APPENDIX G
Sample Building Commissioning Contract

**BUILDING COMMISSIONING SERVICES CONTRACT
BETWEEN OWNER AND COMMISSIONING AUTHORITY
(GSFIC)**

**STATE OF GEORGIA
COUNTY OF FULTON**

PROJECT NUMBER: _____
PROJECT NAME: _____
PROJECT SITE: _____

THIS CONTRACT made the _____ day of _____, 200____, by and between the Construction Division, Georgia State Financing and Investment Commission whose address is Suite 1002, West Tower, 2 Martin Luther King, Jr., Drive, S.E., Atlanta, Georgia 30334, a commission in the Executive Branch of state government in the State of Georgia, hereinafter called the Owner, and _____, whose address is _____, hereinafter called the Commissioning Authority ("CxA"), for building Commissioning services for the above referenced project, hereinafter referred to as the Project.

WHEREAS, Owner requires building Commissioning services for the Project; and

WHEREAS, CxA possesses the skills and experience to provide the building Commissioning services for the Project; and

WHEREAS, Owner selected CxA pursuant to a qualifications-based selection process as required by O.C.G.A. §50-22-5 or 6;

NOW, THEREFORE, Owner and CxA, in consideration of the mutual benefits and promises flowing to each of the parties agree as follows:

ARTICLE 1

1.1 *The CxA's Basic Services* - The CxA's Basic Services are the professional services as set forth in Attachment A, Scope of Basic Commissioning Services, incorporated by reference herein. These services are generally described in "Building Commissioning – Interim Recommended Guidelines" published by the Georgia State Financing and Investment Commission, as amended, hereinafter referred to as the "Guidelines," incorporated by reference herein.

1.2 *Standards* - The CxA shall conform to and be bound by Attachment A, Scope of Basic Commissioning Services, and the Guidelines, and shall perform the Basic Services consistent with all applicable laws and codes in effect at the time the Basic Services are delivered to the Owner. The CxA is fully responsible for any work performed by its consultants the same as if said work were performed, approved, certified, or accepted by it. The CxA, by the execution of this agreement, contracts that it is possessed of that degree of care, learning, skill, and ability that is ordinarily possessed by other members of the its profession and further contracts

that, in the performance of the duties herein set forth, it will exercise such degree of care, learning, skill, and ability as is ordinarily employed by professionals under similar conditions and like circumstances, and shall perform such duties without neglect, and shall not be liable except for failure to exercise such degree of care, learning, skill, and ability. The CxA acknowledges and agrees that, in performing the services for the Project called for in this contract, it shall regard sound principles of design, construction, and operations. By signature on this Contract, the CxA certifies that he or the firm's principal in charge of the performance of the Basic Services is professionally qualified, registered, and licensed to practice in the State of Georgia.

1.3 *Content* – The content for the Basic Services shall generally conform to the content outlined in the Guidelines, for those services within the Scope of Commissioning services set forth in Attachment A.

1.4 *The CxA's Additional Services* - The CxA agrees to perform the Additional Services set forth in Attachment B, Additional Services, incorporated by reference herein.

1.5 *Use of and Reliance Upon the Basic and Additional Services* – The CxA acknowledges that the Commissioning services provided to, or for the benefit of, the Owner include reasonable justification or explanation of the Commissioning Authority's professional decisions, and that those decisions may be reasonably relied upon by the Owner, a contractor, a professional, or any other party delivering services to, or installing work for, the Owner in accordance with the Project for which the Owner retained the Commissioning Authority.

1.6 *Ownership and Copyright* – All Commissioning deliverables, information, data, photos, videos, or documents produced hereunder by the CxA, or its consultants shall be delivered to the Owner, and title thereto shall vest in the Owner regardless of the stage to which the development of the study may have progressed. In addition, the CxA hereby expressly assigns, transfers, and otherwise quitclaims to the Owner, its heirs and assigns forever, all right, title, and interest, including all copyrights and all termination/renewal rights in such copyrights, and all causes of action accruing under such copyrights, in all studies, study calculations, drawings, specifications, other data, embodiments of such studies, documents, or other works of authorship produced hereunder by the CxA, its consultants, or its employees. The CxA further warrants that this transfer of copyrights and other rights is valid against the world. Finally, all original study deliverables and other technical data shall be furnished to the Owner without cost whether the project for which they are made be executed or not. The CxA may make and retain for its use such additional copies as it may desire.

1.7 *Owner's Approvals* - The CxA acknowledges and agrees that the Owner does not undertake to approve, or pass upon, or undertake to inquire into the adequacy, fitness, suitability, or correctness of any Commissioning conclusions. The CxA acknowledges and agrees that the approval or acceptance of the Commissioning services by the Owner is limited to the function of determining whether there has been compliance with instructions issued to the CxA regarding the Basic and Additional Services to be performed. The CxA agrees that no approval of any Commissioning services, program, document, video, photograph, or

APPENDIX G
Sample Building Commissioning Contract

deliverables by any person, body, or agency shall relieve the CxA of responsibility for the adequacy, accuracy, fitness, suitability, and correctness of the services performed in accordance with sound and accepted principles applicable to the services.

1.8 *Administrative and Coordination Services Included within Basic Services:*

1.8.1 The CxA shall arrange and conduct all Commissioning meetings that shall include equipment manufacturers, the designer team, and the construction contractor and/or subcontractors. The CxA shall take minutes of the meeting and distribute typewritten copies to all parties attending the meeting within five (5) calendar days.

1.8.2 The CxA, as the representative of the Owner, shall advise and consult with the Owner during all phases of the services provided.

1.8.3 The CxA shall be responsible for the professional quality, technical accuracy, and the coordination of all studies, tests, designs, drawings, specifications, and other services furnished under this Contract. The CxA shall, without additional compensation, correct or revise any errors, deficiencies, or omissions in the analysis, studies, designs, drawings, specifications, estimates, and other services.

1.8.4 The Owner's review of, approval of, acceptance of, or payment for the services required under this Contract shall not be construed to operate as a waiver of any rights under this Contract or of any cause of action arising out of the performance of this Contract. The CxA shall remain liable to the Owner for all damages caused by the CxA's negligent performance of any of the services furnished under this Contract.

1.8.5 The CxA shall submit to the Owner and Design Team a Commissioning specification for inclusion in the construction contract(s).

1.8.6 The CxA shall submit a Commissioning Schedule, for the Owner's review and approval, of the Basic and Additional Services set forth in Attachments A and B. The Commissioning Schedule shall outline all times, projections and milestones for all reviews, meetings, investigations, and other portions of the Project. The CxA shall develop the Schedule and shall submit the preliminary schedule within ten (10) working days of execution of this contract. The Project Construction Schedule shall incorporate the Commissioning Schedule as developed by the Design Team and the Constructors. All Commissioning services shall be coordinated with the actual construction progress.

APPENDIX G
Sample Building Commissioning Contract

1.8.7 The warranty period shall be as defined in the Specifications (normally one (1) calendar year from the date of Final Acceptance of the Project by the Owner). The CxA shall provide the Basic and Additional Services as needed for the full term of the warranty period. The CxA shall attend all warranty inspections to determine if any defects in the Work exist. The CxA shall notify the Owner (verbally within 24 hours of the inspection and followed up in writing within five (5) days of the inspection) of any defects, and whether or not the defective work is covered by the warranty. The CxA shall notify the Owner in the same fashion of any defective work the CxA may identify at any time on the Project.

ARTICLE 2

2.1 *Fees* – The Owner shall pay the CxA a Fee of \$_____ for the Basic Services. The Owner shall pay the CxA for Additional Services an Additional Fee to be negotiated and recorded upon Attachment B. The Fee may be increased by mutual agreement if further additional services are needed. Payment shall be as set forth in Article 5 below.

2.2 *Reimbursements* - The Owner will not make reimbursement for any expense unless the Owner requests the expenditure and approves it in advance. Transportation costs, living expenses, reproduction costs, courier service costs, and long distance telephone charges shall not be reimbursable unless the Owner grants written approval for these expenditures in advance.

2.3 *Time for Completion* – Unless modified in Attachment A, the time for completion of the Basic and Additional Services shall be consistent with the design and construction schedules, and warranty period. Non-warranty services and off-season testing shall be completed prior to the completion of the Project. The Owner, may permit in writing, in its sole discretion, certain designated Commissioning services to be completed after occupancy, but shall set a date certain for completion if such permission is granted. Should Owner-initiated changes in the requirements result in substantial re-work of the Basic Services, the Owner and CxA shall mutually negotiate both an additional fee and any required extensions of time.

ARTICLE 3

3.1 *Special Additional Services* - Payment for special consultants or special studies when requested by the Owner and agreed to by the Owner and CxA in advance shall be in addition to the payments for Basic Services defined in Attachment A and Additional Services defined on Attachment B.

3.2 *Hourly Rates* - The hourly rates to be included in the invoices of the CxA for Special Additional Services agreed to under Article 3.1 and not contained on Attachment B shall be as follows:

- (A) For principals of the CxA and for principals of firms engaged as consultants shall be a rate of \$150.00 per hour.

APPENDIX G
Sample Building Commissioning Contract

- (B) For registered professionals of the CxA and for registered professionals of the firms engaged as consultants shall be a rate of \$125.00 per hour.
- (C) For drafters of the CxA or firms engaged as consultants shall be a rate of \$75.00 per hour.
- (E) For administrative personnel of the CxA or firms engaged as consultants shall be a rate of \$40.00 per hour.

ARTICLE 4

4.1 *Owner's Option for Additional Professional Services* – Owner reserves the right—which right may be exercised in Owner's sole and absolute discretion, without the necessity of further competitive selection processes, including any further process under O.C.G.A. §50-22-1 *et seq.*—to select CxA as the professional consultant for other additional or special additional services to the Project and to negotiate an amendment to this contract or to negotiate a separate professional services contract for such professional services.. Owner is under no obligation to select CxA for any additional professional services for this Project, and may conduct a new qualifications-based selection process as my required by O.C.G.A. §50-22-5 or 6. CxA is entitled to no additional compensation, other than for the Basic, Additional and Special Additional Services provided herein, from Owner should Owner elect not to exercise its option under this paragraph.

4.2 *Separate Contracts* - Unless agreed to in writing by the Owner, the various components of the Project may be awarded under separate contracts, including this contract, professional services contracts, an Architectural Design Contract, and one or more construction contracts.

ARTICLE 5

5.1 *Payments* - The CxA agrees that:

- (A) Invoices for Fees for Basic, Additional, and Special Additional Services shall be submitted monthly for payment by the Owner and shall be based on the CxA's good faith estimate of percentage of services actually complete at the time of the billing, plus any completed Additional Services and reimbursable expense previously approved by the Owner.
- (B) Requests for reimbursable expenses shall be submitted with the monthly invoices for fees and allocated by person to whom the expenses apply, accompanied with copies of receipts and invoices as set forth in the latest rules and regulations promulgated by the State Auditor for travel expenses.
- (C) Final payment for Basic Services, Additional and Special Additional Services, and for final reimbursable expenses shall not be due and

APPENDIX G
Sample Building Commissioning Contract

payable until the Owner has accepted and approved the Basic, Additional and Special Additional Services as complete.

5.2 The CxA shall make payments to its consultants not more than ten (10) working days following receipt of payment from the Owner. Statements of the CxA for fees subsequent to the first statement must contain a notice that "all consultants have been paid in full to the extent that the CxA has been paid." If this certification cannot be made, the CxA must affirmatively state for each such consultant the amount not paid and the reasons therefor.

ARTICLE 6

Assignment -The CxA hereby agrees that the Owner may, if it wishes to do so, assign this contract to another governmental entity. The CxA hereby agrees that it shall not assign, or transfer any interest or right in this Contract in whole or in part to any party without the written consent of the Owner in advance.

ARTICLE 7

7.1 *Professional Liability Insurance* - Within ten days after execution of this Contract and during the entire period of the contract, the CxA shall maintain professional liability insurance applicable to the work being performed. The CxA shall file with the Owner a certificate of insurance from an insurance company licensed to do business in the State of Georgia showing evidence of such professional liability insurance (errors and omissions insurance) in limits of not less than \$1,000,000 per claim. Any deductibles and self-insurance retention may not be greater than \$25,000.

7.2 *Workers Compensation and General Liability insurance* - Within ten days after execution of this Contract and during the entire period of the contract, the CxA shall maintain Workers Compensation and General liability insurance as provided herein. The CxA shall file with the Owner a certificate of insurance from an insurance company licensed to do business in the State of Georgia showing evidence of workers compensation insurance meeting statutory requirements and commercial general liability insurance limits of not less than \$1,000,000 per claim and \$2,000,000 in the aggregate.

ARTICLE 8

8.1 *Termination for Convenience of the Owner (Without Cause)* - The Owner may at any time, and for any reason or without any reason or cause, terminate this contract by written notice to the CxA specifying the termination date, provided that in the event of termination under this provision the Owner shall pay to the CxA all fees properly due (i) for services already properly performed prior to the effective date of the termination and (ii) for all reimbursable expenses properly incurred. In the event of such termination the CxA shall have no claim in excess of what is allowed in this Article 8.1 for any sum of money, however denominated, as a result of or relating to such termination.

APPENDIX G
Sample Building Commissioning Contract

8.2 *Termination For Cause* - In the event the CxA through any cause fails to perform any of the terms, covenants, or provisions of this contract on its part to be performed, or if it for any cause fails to make progress in the work hereunder in a reasonable manner or if the conduct of the CxA impairs or prejudices the interests of the Owner or the Firm violates any of the terms, covenants, or provisions of this contract, the Owner shall have the right to terminate this contract by giving notice in writing of the fact and date of such termination to the CxA, and all study deliverables and other documents relating to the Basic Services shall be surrendered forthwith by the CxA to the Owner, PROVIDED, HOWEVER: That the CxA shall have five (5) business days from the date of the notice to cure the defects, and PROVIDED FURTHER: That in such case the CxA shall receive equitable compensation for such services as agreed between the parties, or, in the event of an inability to agree, shall in the opinion of an independent auditor selected by the Owner and paid for by the Owner to which the CxA shall have no reasonable objection, to have been satisfactorily performed by the CxA up to the date of termination of this Contract. The parties agree that the decision of the said auditor concerning the matters set forth in this Article 8.2 shall be final.

ARTICLE 9

Personal Work - In contemplation that the Commissioning services to be performed are personal services, the CxA hereby agrees that no material change in the business organization under which the firm shall perform the present contract may be made without written consent of the Owner in advance, and such consent of Owner may be credited upon retention of the key staff persons of the CxA for performance of the work. The CxA must provide revised tax identification numbers prior to payment of the invoice following any such change.

ARTICLE 10

10.1 *Modifications to the Contract* - The CxA covenants that no modifications, either written or oral, may be made in the terms and provisions of this Contract without the written consent in advance of the Owner. It is agreed between the CxA and the Owner that, in the absence of such written consent, neither any modifications nor any undertaking to modify the contract shall be binding but shall be absolutely null and void.

10.2 *Superseding Of Earlier Agreement And Fees* - The parties hereto agree that these presents take the place of and supersede entirely any existing contracts, agreements, arrangements, understandings, undertakings, courses of dealing, or customs and practices, either implied or express and whether written or oral, in regard to the Project. This contract represents the entire and integrated agreement between the Owner and the CxA and may be amended only by written instrument signed by both the Owner and the CxA.

ARTICLE 11

11.1 *Prohibited Acts* - The CxA by execution of this contract warrants that it has not employed or retained any company or person, other than a bona fide employee working solely for it, to solicit or secure this contract and that it has not paid or agreed to pay any person, company, corporation, individual, or firm, other than a bona fide employee working solely for it, any fees, commission, percentage, gift, or other consideration contingent upon or resulting from the award or making of this contract.

11.2 *Minority Participation Policy* - It is the policy of the State of Georgia that minority business enterprises shall have the maximum opportunity to participate in the State purchasing and contracting process. Therefore, the State of Georgia encourages all minority business enterprises to compete for, win, and receive contracts for goods, services, and construction. In addition, the State encourages all companies to subcontract portions of any State contract to minority business enterprises. CxAs who use qualified minority subcontractors may qualify for a Georgia state income tax deduction for qualified payments made to minority subcontractors. See O. C. G. A. §48-7-38.

11.3 *Drug-Free Work Place* - The CxA acknowledges that it is fully aware of the contents and requirements of O.G.C.A. §50-21-1 *et seq.* of the Official Code of Georgia. The CxA, by execution of the present contract, does hereby certify that it and its consultants are in compliance with the aforesaid code section.

11.4 *Full Performance* - The Owner and the CxA hereby agree to the full performance of the terms, duties, obligations, responsibilities, conditions and stipulations contained herein.

11.5 This Agreement shall be construed and enforced according to the laws of the State of Georgia.

APPENDIX G
Sample Building Commissioning Contract

IN WITNESS WHEREOF, the parties have each caused these presents to be duly signed, sealed, and delivered by their duly authorized representatives on the day, month, and year first above written.

COMMISSIONING AUTHORITY: _____

By: _____

Name: _____

[SEAL]

Title: _____

OWNER: _____

By: _____

Name: _____

[SEAL]

Title: _____

APPROVED (Using Agency): _____

By: _____

Name: _____

[SEAL]

Title: _____

APPENDIX G
Sample Building Commissioning Contract

ATTACHMENT A
SCOPE OF BASIC COMMISSIONING SERVICES

[To be detailed by the Owner]

**ATTACHMENT B
SCOPE OF ADDITIONAL SERVICES**

{Note that, in the version of this attachment that the Agency should prepare, words inside the square brackets [] and the brackets themselves will be replaced by Agency specific requirements. The fill-in here is given for example only.}

The CxA shall provide training services as follows:

- The CxA shall develop a training program for existing O&M personnel of Owner, consisting of *[for example, an eight-hour course, including both platform instruction and hands-on training of the commissioned systems on the Project]*.
- The CxA shall develop and provide to the Owner a Training Manual to supplement the training program and provide for Owner-led training of new employees.
- The CxA shall present the training course two times to facilitate attendance by all of Owner's O&M personnel and appropriate administrative personnel. While administrative personnel may attend, the training is to be structured most effectively for O&M personnel. The Owner shall provide a training room adequate for the platform training, and shall provide services for copying training materials as needed.
- The CxA shall coordinate all training provided by the General Contractor.
- The CxA shall provide a videotape and catalogue of each training session.
- The CxA shall provide the Additional Services on this Attachment B for a Lump Sum Fee of \$_____. If additional training sessions are requested by Owner, each shall be conducted for a supplementary Fee